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Art. I. *An Introductory Discourse, delivered in the Amphitheatre of the London Institution, on Wednesday, the 5th of May,* 1819. *By* William Thomas Brande, *Sec. R. S. and Professor of Chemistry in the Royal Institution of Great Britain.*

I HAVE been honoured by the request of the Board of Management of this Institution, to deliver a course of lectures on the Principles of Chemical Science; and, highly as I am flattered by the distinction which they have thus deemed it right to confer upon me, I should feel uneasy and embarrassed, were I not, on this occasion, and at the very threshold of my undertaking, to assure you that I have acquiesced in their wish, under the impression of considerable diffidence, and a somewhat painful anxiety; that I had hoped and expected that a task so arduous and important, would have devolved upon an abler Professor, and would have been consigned to one of more eloquence and ability than the very humble individual who now stands before you, to plead the cause of science. I should, indeed, have altogether declined the office, and shrunk from its responsibility, had not experience already convinced me that candour and kindness would be the prevalent feeling of my audience, and that they would dispense these in direct proportion to my wants, if they find my exertions unremitting; my zeal unextinguishable; and my desire, limited only by my power to excel.

Under these impressions, I enter upon my design, not with fear and trembling, but with confidence and alacrity; rejoicing in the opportunity of shewing my zeal in the cause in which we are embarking; and of conducting you, to the best of my abilities, into the enchanting realms of experimental science.

On account of many circumstances, which it is quite unnecessary to recur to, no attempt will be made, during the present season, to institute a regular series of philosophical or scientific instruction; to speak the truth, our means are inadequate to such an undertaking; our forces are scattered, and it will require time, and skill, and exertion, to marshal them into order, and to bring them, duly equipped, into the field: indeed, it is to the unremitting zeal and activity of your Board of Management, that such arrangements, in respect to apparatus and assistants, have been made, as enable me, upon the present occasion, to open my course with the most ample confidence that nothing will ever be wanting on their part, to furnish such auxiliaries and supplies with a liberal and discerning hand.

As chemical science will form a feature, and, I trust, a prominent one, of the various courses of information and instruction, that are to issue from this room, it shall be my earnest endeavour to lay before you, in simple, but perspicuous terms, the leading objects of that important and beautiful department of physical knowledge; to make you acquainted with some of its already atchieved conquests in the dominion of nature; and to expose some of the probable results of its future progress; and I propose to fulfil these intentions by an experimental inquiry into the powers and properties with which matter is endowed, and which, as it were, preside over its chemical energies, causing, modifying, or preventing them. These, I hope, will soon be rendered familiar to you under the heads of attraction, heat, and electricity, for such these powers are.

It shall be my great object to accomplish these ends in the most clear and perspicuous manner; to divest those branches of science that I am to deal with, of all abstruse and recondite terms; to destroy the fortification of hard words and hidden meanings with which they are sometimes surrounded; and to shew that they may really be brought home to the business and bosoms of men.

But, before I proceed to any further remarks, or expatiate upon the particular objects and ends of my own department of knowledge, it becomes me to remember, that we are to-day, for the first time assembled within these walls, to pay our tribute to literature and science at large; that the doors are opened to every range of scientific inquiry, and classical erudition; to every attainment which can expand, embellish, and improve the mind of man. Under these circumstances, I say, it becomes me to speak in more general terms; and I shall, therefore, endeavour to set forth a few of the advantages that society may expect to derive from this munificent establishment; to shew how far it merits your patronage; and to convince you that, in the work we are undertaking, regard is not merely to be had to its immediate consequences, but that we are to consider its influence upon aftertimes, and to look to the benefits that it is to diffuse upon generations yet to come. And I am convinced that I shall be able to shew, that in establishing this Institution in the heart of the city of London, you have done a great and glorious deed for posterity; you have opened a fountain which will never be dried up, but will continue to flow into, and fructify, the commonwealth of science for ages yet to come.

The projectors of this Institution deserve our first thanks; they have shewn the fallacy of the opinion entertained by the greatest political philosophers; and have demonstrated, that high commercial rank and wealth are not incompatible with enlarged minds, liberal views, and cultivated understandings. We are told that, considering the mercantile eminence of their country, and persuaded that whatever increases the splendour, increases equally the strength and activity of commerce, they thought it due to the dignity and glory of the empire, that her commercial metropolis should be graced by a literary and scientific Institution, on a liberal and extensive plan. They judged, and wisely did they judge, that such an establishment would make commerce acquainted with science; and that, by their approximation, each would draw forth and invigorate whatever there might be of latent energy and power in the other. We accordingly find that, under this liberal and creditable feeling, they submitted their views to the consideration of their fellow-citizens, and solicited their co-operation; that their design was universally approved, and that a subscription of considerable amount was almost immediately raised within the walls of our city.

Such was the auspicious beginning of this establishment. A portion of land was then purchased, and on the 4th of November, 1815, the first stone of the building in which we are now assembled was lowered into its place by the Mayor of London. As the building advanced, its growing wants were met with proportionate liberality, and a magnificent library and amphitheatre, with their various auxiliary apartments, have been at length brought under the same roof, constituting one of the noblest ornaments of the city of London.

I shall first ask your permission to dilate somewhat upon the immediate advantages and benefits which may reasonably be expected to result from this undertaking, and to crown the splendid exertions of its founders and patrons; let us here, however, pause for a moment, to express our earnest wish and humble hope that the great Disposer of events may approve of the motives of this assembly; that His blessing may rest upon the work; that He may render it, in our hands, subservient to the great and disinterested purposes of extensive utility, which it is its sole object to attain; and that in future times this edifice may be the glory of our children's children; that commerce and science may here be entwined in perpetual friendship, uniting their strength for the glory of the empire, the stability of the throne, the perpetuity of our glorious constitution, and the prosperity of the people at large.

The intimate union that subsists between science and commerce, and between literature and the arts; the individual, and, therefore, the public improvement to which this union tends; its influence in elevating, in the rank of nations, the countries that are blessed by its happy influence, are truths inculcated by our knowledge of the world, and with illustrations of which every page of history teems. But history also records the downfall and degradation of learning; she shews us that, where Science and the Arts once flourished in all their vigour, and grew, as it were, in a native soil, they subsequently withered and decayed, leaving little else behind than a few solitary relics, which, like the ruins of some great edifice or temple, in the midst of a barren plain, tell us that magnificence once dwelt, where we now see nothing but sterility and desolation. Such are the truths recorded by the unerring pen of history, which has shown that even when knowledge and taste had been interwoven with the very manners and habits of a people, and disseminated amongst large and prosperous nations, frequent instances have occurred of their utter loss and obliteration; insomuch that their very existence would be problematical, were it not for the undeniable proofs, which they have left of their former excellence, and which, measured by the powers and capacities of succeeding ages, appear like the productions of a superior race of beings.

Thus, as one ofour poets has beautifully expresssed it, "the dawn of human improvement seems to have smiled upon that fabric which it was ultimately to destroy, as the morning sun gilds and beautifies those masses of frost-work, which are destined to vanish before its meridian splendour."

Reasoning upon these things, historians have sometimes gloomily denounced those happy emotions which a nation rising to eminence is apt to produce in a liberal and humane mind: they have talked to us of the declension of our natural energies, and have told us, that all our struggles and exertions, though tending to temporary splendour, will ultimately be involved in a desolate abyss; that the productions of age, can stand in no competition with the vigorous sallies of youth. From the days of Homer, this has been the burthen of the poet's song, and the opinion has, in many cases, received the deliberate sanction of the philosopher. Adverting to this subject, a late eloquent writer* has observed, that although opinions mostly obtain credit by their antiquity, this opinion, in particular, derives no advantage from that circumstance; on the contrary, that very antiquity is the most decisive proof that it is wholly unfounded. If, says he, the human race had declined from its pristine vigour between the period of the Trojan war and the time of Homer, to what a degree of imbecility must it have fallen in the reign of Augustus. "And if, in like manner, the complaint of the Roman poets, of the deterioration of the human race be well founded, to what a miserable state of degradation must it before this time have been reduced. After so long a descent, is it possible that nature could still have produced a Dante or an Ariosto, a Corneille or a Racine, a Shakspeare or a Milton; names which amply show that her vigour is not exhausted, but that she still continues to bring forth the fruits of the mind no less than those of the earth?"

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* Mr. Roscoe.

If we ascend from poetry to those nobler and more divine energies of the human mind which are employed in the search after truth; in removing the film from the intellectual eye of man; in developing the mechanism of nature by experimental research; we have only to mention the names of Kepler, Galileo, and Copernicus; of Boyle, Bacon, Newton, and Hooke, to show, that here nature has neither retrograded, nor remained stationary. It is folly, therefore, to assert, that the golden age has passed away, and that man is suffering corporeal and intellectual degradation. On the contrary, let us hope, that if not baffled by its own perverseness, the human race is really tending, in regular and progressive course, towards improvement, and that every age of the world is more enlightened than that which preceded it. We know that history does not exactly bear us out in these hopes, but we shall presently be able to trace the cause of such disappointment, and to calculate upon the probability of its continuance.

Among the causes that have contributed to those vicissitudes of the human energies of which we have been speaking, some have, I think, ignorantly adduced local situation and climate; but let us remember one contradictory instance only, and it will be sufficient to confute such a notion. "Let us remember that the Greeks rose from the very dregs of barbarism till they became the masters of the world, and that that very Greece which was so long the garden of Europe, afterwards became a sterile desert. Bœotia lay in the vicinity of Attica, and consequently enjoyed the same climate; yet were the Bœotians as dull as the Athenians were acute. The splendour too of Grecian science was diffused not only through Greece itself, but extended to colonies far distant from the metropolis, and very different with respect to climate*."

There are writers who have told us, that there is a tide in the arts and sciences which always tends to their elevation and declension; and further, that when they come to perfection in any state, they necessarily decline, and seldom or never revive in that nation where they had formerly flourished. To the general truth of these remarks, history and experience oblige us to assent; but, instead of resting content with the fact, and acquiescing in its necessity, let us endeavour to trace it up to its cause, and to ascertain whether such fluctuations are really ordained by nature, or whether they arise from the untoward propensities of man.

In thus viewing the subject, it will presently be apparent, that there are direct and immediate causes for that obliteration and declension of science and art that we have just adverted to; that it has always been indicative of a degradation in the moral character of the people; characteristic of declining liberty, and of overwhelming oppression; of the rise of despotism, and the fall of freedom: That wherever these causes have co-operated, the best feelings and energies of the human mind have been blasted; effeminacy and indolence have slided into the place of manliness and activity; vice has gained the ascendancy over virtue; and all that is estimable in the human character, all social virtues and public spirit, have dwindled into selfishness and deceit. It is then to public morals and public liberty that we are to look up as the shield and helmet of the arts and sciences, and as constituting the anchor of their salvation. Under a jealous and suspicious government, be it republican or monarchical, the faculties and energies of the people are palsied and frozen up. Under a free constitution, the mind is neither agitated by apprehension, nor deadened by jealousy and suspicion; freedom of inquiry and of expression are interwoven with its very existence, and all the noblest characters of man shoot forth with vigour and blossom in security.

In the inaugural oration which was spoken by the eloquent and learned Counsel to this Institution, at the ceremony of its foundation, these principles were well illustrated, by directing our attention to the spacious provinces which now compose the Ottoman empire, but which once were the seat of science and of commerce. Then were they dignified by wisdom and valour, and were the fairest portion of the Christian world. But when the tyranny of their invaders deprived them of these inestimable blessings, no tongue can adequately describe the sad and melancholy reverse. Large territories dispeopled, goodly cities made desolate, sumptuous buildings become ruins, glorious temples subverted or prostituted; true religion discountenanced and oppressed; all nobility extinguished; violence and rapine exulting over all, and leaving no security except to abject minds and neglected poverty. Such is the state of a country without religion, and morals, and freedom: Would you behold a country in possession of them, look to your own; contemplate the number and magnificence of her cities, the high state of her agriculture, the activity of her manufactures, the easy intercourse between all parts of the nation; her grand foundations both for learning and charity; the graceful dignity and conciliating ease of high life; the importance and respectability of the middle ranks; the industry and intelligence of the lower; the general veneration of the constitution; the general obedience to the law; the general devotion to their country.—Such is Britain. If it be inquired by what means she has attained this height of glory and prosperity, we must refer it, under the blessings of Providence, to our intellectual liberty, to the respect in which morality and religion are held by the public; and lastly, to that happy union of science and commerce, for which, in every part of her history, she has been eminently distinguished.

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* See the Abbé Andres, as quoted in Mr. Roscoe's Discourse, delivered at the opening of the Liverpool Royal Institution.

If from the earlier we descend to more recent times, to the period which has elapsed since the revival of letters, and which followed that melancholy chasm in the intellectual and moral history of man, commonly called the middle ages, we shall find, that here also the same great truth is inculcated, the same relationship exhibited between ignorance and prejudice, and vice and slavery; between freedom and independence on the one hand, and every quality which adorns the intellectual capacity of man, on the other.

Towards the beginning of the 15th century, we discern the germs of those innovations which tended to the revival of letters in Europe; the landscape began to re-appear, after the inundation of barbarism with which it had been overwhelmed for the protracted period of nearly a thousand years, and various circumstances cooperated to give a new impulse and activity to causes which had long lain dormant, " for in no one age, from its commencement to its close, does the continuity of knowledge seem to have been entirely interrupted; there was always a faint twilight, like that auspicious gleam which in a summer night fills up the interval between the setting and rising sun." These causes have been so admirably summed up by Dr. Robertson, in his View of the Progress of Society in Europe, from the subversion of the Roman Empire to the beginning of the 16th century, that I shall not attempt either to abridge or recapitulate them. The revival of letters was followed by the Protestant reformation, and by the invention of printing. The former encouraged a freedom of inquiry into religious matters, which diffused a congenial liberality of sentiment over other subjects of investigation; in philosophy it tended to dispel the trifling cavillings of Aristotle concerning matter, form, motion, and time; and it gradually led to the substitution of reason for habit, as a governing principle.

The invention of printing was also attended with most important effects upon the human mind. For us, says an elegant writer upon this subject*, who have been accustomed from our infancy to the use of books, it is not easy to form an adequate idea of the disadvantages which those laboured under, who had to acquire the whole of their knowledge from universities and schools; blindly devoted, as the generality of students must then have been to the peculiar opinions of the teacher who first unfolded to their curiosity the treasures of literature and the wonders of science. Thus, error was perpetuated, and instead of yielding to time, acquired additional influence in each successive generation. In modern times, however, this influence of names is at an end. The object of a public teacher is no longer to inculcate a particular system of dogmas, but to prepare his pupils for exercising their own judgments. There is another circumstance which also especially merits attention, namely, the influence of the foregoing ~~causes~~ in encouraging among authors the practice of addressing the multitude in their own vernacular tongues. To the zeal of the reformers we owe this invaluable innovation; the sacred books were in almost all the kingdoms and states of Europe, translated into the language of each respective people, and from that moment the prejudice began to vanish which had so long confounded knowledge with erudition, and a revolution commenced in the republic of letters analogous to what the invention of gunpowder produced in the art of war. "All the splendid distinctions of mankind," as the champion and flower of chivalry indignantly exclaimed, "were thereby thrown down, and the naked shepherd levelled with the knight clad in steel."

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* See Mr. Dugald Stewart's Dissertation, prefixed to the *Supplement to the Encyclopædia Britannica.*

I have now, I trust, adduced sufficient evidence to prove the active causes that tend to the progress and welfare of literature, science, and art; to these we are to look, as the sources of those glorious conquests which were made in Europe within two centuries after the revival of letters; and it was under such auspicious influence, that in the reign of Elizabeth, the English mind put forth those unrivalled energies that conduce to the enthusiastic reverence with which we mention the names of Spenser, of Shakspeare, and of Milton,

> Whither, as to their fountain, other stars
> Repair, and in their turns draw golden light:

and which, concentered in Bacon, stamp him as the greatest, most universal, and most eloquent of philosophers; whose doctrines, compared with the subtleties of the schools, are as the noon-day sun, to the transitory meteors that float in the earth's atmosphere.

From these considerations, I am conducted to the second object of this Introductory Discourse, in which I am to endeavour to show the intimate union that subsists between the scientific and commercial interests of a country, and especially of Great Britain.

To shew the necessary connexion that subsists between the progress of the sciences and that of the useful arts, and between commerce and intellectual improvement, will, I trust, become one of the leading objects of public instruction in this Amphitheatre; for it will not only stimulate to exertion by the flattering picture of human ability and resources which it displays, but will also show how much the happiness and perfection of our nature is concerned in the exercise of our relative and social feelings; how nearly our interests are connected where they often appear widest apart. The philosopher, says Dr. Johnson, may very justly be delighted with the extent of his views, and the artificer with the readiness of his hands; but let the one remember, that without mechanical performances, refined speculation is an empty dream; and the other, that without theoretical reasoning, dexterity is little more than a brute instinct. It is, says he, pleasing to contemplate a manufacture, rising gradually from its first mean state, by the successive labours of innumerable minds; to consider the first hollow trunk of an oak, in which, perhaps, the shepherd could scarce venture to cross a brook swelled with a shower, enlarged at last into a ship of war, attacking fortresses, terrifying nations, setting storms and billows at defiance, and visiting the remotest parts of the globe. And it might dispose us to a kinder regard for the labours of one another, if we were to consider from what unpromising beginnings the most useful productions of art have probably arisen. Who, when he saw the first sand or ashes, by a casual intenseness of heat, melted into a metalline form, rugged with excrescencies, and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniencies of life as would in time constitute a great part of the happiness of the world? Yet, by some such fortuitous liquefaction was mankind taught to procure a body at once in a high degree solid and transparent, which might admit the light of the sun, and exclude the violence of the wind; which might extend the sight of the philosopher to new ranges of existence, and charm him at one time with the unbounded extent of the material creation, and at another with the endless subordination of animal life; and, what is yet of more importance, might supply the decays of nature, and succour old age with subsidiary sight. Thus was the first artificer in glass employed, though without his own knowledge or expectation. He was facilitating and prolonging the enjoyment of light, enlarging the avenues of science, and conferring the highest and most lasting pleasures; he was enabling the student to contemplate nature, and the beauty to behold herself.

It would be easy to trace other arts, and other manufactures, to their recondite and remote sources, and to display the most unexpected and important events springing from trifling causes, and of an apparently undignified origin. To shew in the interwoven boughs of the grove, and the rude attempts of unlettered nations, the elements of Gothic and Grecian architecture. To discover the simple clothing of rude and barbarous countries, composed of the barks of trees and skins of animals, gradually merging into more and more complicated manufactures, in which usefulness and comfort are blended with beauty and elegance; to exhibit the simplest methods of reckoning time, the hour-glass, or the graduated candle, slowly leading to the pendulum-clock, and chronometer.

In all the arts, and in every branch of science, there has been the same slow, yet certain, progress; and in tracing their gradual progression, we shall ever find it most rapid and complete in those countries where commerce and her attendants thrive and are cherished.

Under the influence of commerce, the barren islands of Venice gradually became the seats of wealth and magnificence, and the abode of literature, science, and the fine arts; and it will, perhaps, be remembered by many present, that, in his Inaugural Oration already quoted, your learned Counsel pointed the attention of his hearers to the splendour of the towns of Belgium, to their numerous public edifices of exquisite and costly architecture, and to the numberless paintings, and works in marble, gold, silver, iron, and bronze, with which they abound; and desiring us to recollect that, during a period of about two hundred years, all these cities have been in a declining state, reminded us of what they were in the sunshine of their prosperity. He told us, and truly too, that the fostering hand of commerce collected all these treasures. For, said he, till the imprudent conduct of the Dukes of Burgundy, and of the house of Austria, drove commerce to Amsterdam, the Netherlands were her favourite seat; and all these monuments of art and science owe their existence to the commercial acquisitions, and well-directed munificence of the burghers of Bruges, Ghent, Antwerp, Brussels, and Louvaine.

With the commercial history of our own country, my audience cannot but be well acquainted. To point out the benefits flowing from its commercial aggrandizement would, indeed, be a pleasing labour, full of substantial and solid gratification, but we need only look around us, and every object that meets our eye proclaims the debt that is due to commerce; the very walls that surround us speak, and tell us that they were raised by her for the protection of science. But the amount of this debt is rendered most obvious by considering our own country in its natural aspect, without any of the benefits and advantages of commerce, and we then presently discern, that without her, science would have been debarred of all her essential aids; she brings to our marts the produce of every climate; converts our tin into gold, and our wool into rubies. "I have often fancied," says Addison, in one of his essays on the benefits of commerce, "when I have been upon 'Change, one of our old kings standing in person where he is represented in effigy, and looking down upon the wealthy concourse of people with which that place is every day filled. In this case, how would he be surprised to hear all the languages of Europe spoken in this little spot of his former dominions, and to see so many private men, who, in his time, would have been the vassals of some powerful baron, negotiating like Princes, for greater sums of money than were formerly to be met with in the royal treasury."

While we are thus contemplating the means and power of commerce, and reflecting upon the liberal aid which science has received at her hands, let us not be unmindful of what remains to be done; let us hope that the acquaintance thus auspiciously begun, may advance to intimacy, friendship, and regard; and that the mural crown of our city, already the emblem of dominion and strength, may embrace within its protecting circle the interests of science, and become adorned by the rays of intellectual light.

If commerce has, in many instances, munificently contributed to the promotion of science, science has, on the other hand, rendered liberal and essential service to our commercial interests; and of the various branches of science, chemistry stands, in this respect, foremost in the first rank; so important, indeed, is it to the progress of society, that no people ever attained any considerable degree of civilization, independent of the chemical arts. The steam engine is generally and universally allowed as the most noble and effective present ever made by philosophy to the arts: and, considered in the abstract, it is indeed singularly calculated to excite our admiration and surprise; but when we carry our eye from the simple instrument, to its applications, and when we view the numerous branches of manufacture that depend upon it as their prime mover, the understanding is scarcely capacious enough to grasp them, and wants power to do homage to those by whose skill and industry this machine was perfected, and tamed, as it were, into submission. Let me recommend those who complain of the introduction of machinery into our manufactures, and whose clamours are loud against this substitute for manual labour, to reflect upon the state we should have been in without it. One of two things must, in that case, have happened. Either our fields must have been overrun by invaders, and our importance in the scale of nations degraded into something worse than nonentity, while those who have so gloriously defended us abroad were busied at home at the loom and the distaff; or our traffic must have stagnated; and our trade, instead of having been shaken only, would have been wholly subverted and annihilated. Let us then be thankful that our liberties are preserved to us entire; that although we have indeed felt the shock which has palsied so great a portion of Europe, and reduced many of its states to trembling imbecility, we are still suffered to live, and breathe, and enjoy our being; and let us, above all things, seriously and stedfastly exert ourselves to avert the difficulties that surround us, with that manly and temperate zeal which becomes the British character.

Among the useful arts, it is difficult to select one that is not very immediately dependant upon chemical principles, and in reverting to the history of those arts, we shall find ourselves obliged to confess, that their leading improvements have been derived from the same source. It would be trite and tedious to enumerate all that chemistry has done for the arts of bleaching, dyeing, calico-printing, and tanning. In the arts of pottery, of glass, and porcelain making, or in the apparently more remote operations of the brewer and the distiller; but it may not be useless to inform you, that the discovery of the present mode of making oil of vitriol, of preparing vinegar from wood, of extracting the pure acid from the lemon; that the abstruse and apparently abstract inquiries into the propagation and effects of heat, are so many sources whence these improvements have been derived, and whence individuals, often ignorant of their origin, have enriched themselves, and benefited the community. I the rather dwell upon these things, because it is a common, though a gross error, to depreciate the abstract inquiries of the philosopher and the chemist; to consider all as empty and idle that does not contribute to immediate instruction or profit; forgetting how frequently it has happened, that even he who has excited the derision of his contemporaries, has merited and received the gratitude of posterity. "If what appears little be universally despised, nothing greater can be attained, for all that is great was at first little, and rose to its present bulk by gradual accessions and accumulated labours."

To enumerate all the advantages which science has conferred upon the arts, and thence to deduce its influence upon the welfare of our commercial interests, would lead me to inquiries of such extent and importance, as to exceed my adequacy to do justice to them; I can only recommend the investigation as well deserving attention, and more especially to those who sceptically deny the happy results of the intercourse between Science and Art.

Before I take my leave, I feel it my duty on this occasion, to advert to, and answer some objections that have been urged against literary and scientific establishments, considered in their relation to the mercantile world, and as affecting particular classes of society.

It has been said, that literary and scientific attainments are incompatible with that attention to business, with that activity of mind, which is essential to those who would flourish in mercantile and commercial occupations; and it has been supposed, that the young man who is just entering upon the career of life, is particularly open to such objectionable and unpropitious influence. But let us candidly and dispassionately look at the state of this question. There is no one whose mind can always and incessantly bear direction to one subject; whose thoughts will always run in the same channel; the bow must sometimes be unstrung; diversity of occupation must be resorted to for relief; and amusement must sometimes become our business. Whatever our occupation may be, some degree of variety and relaxation is required, and it is admitted upon all hands, that if these gaps and chasms in the life of a man of business are not employed in the acquisition of some kind of information, or in the cultivation of some branch of literature, science or art, they will seldom remain harmlessly employed. There are fortunately very few whose minds are so degenerate as to rest quiet in absolute idleness; and if these do not resolve to be industrious, they will seldom be employed without injury to themselves or others; unable to contain themselves in a neutral state, they invariably sink into vice, when no longer soaring towards virtue. It is indeed so absurd to suppose, that the attention of a man of business is to be injured and distracted by occasional incursions into the regions of literature and science, that all objections to establishments like ours, founded upon such imputations, require only to be mentioned, in order to be rejected as the vapid miasmata of ignorance, or despised as the illicit offspring of prejudice and credulity. The mind of man was never intended for an "unweeded garden", but was formed for cultivation and embellishment. By the union of literature and science with the ordinary affairs of the world, we not only derive present enjoyment, but lay up a stock of future satisfaction, which tends to recreate the languors of age, and to shed a lustre upon the evening of life. How different must be the view of past life in the man who is grown old in knowledge and wisdom, from that of him who is grown old in ignorance and folly! The latter is like the owner of a barren country, that fills his eye with the prospect of naked hills and plains, producing nothing either profitable or ornamental; the other beholds a beautiful and spacious landscape, divided into delightful gardens, green meadows, fruitful fields; and can scarce cast his eye on a single spot of his possessions that is not covered with some beautiful plant or flower."

The last, and I trust to the present audience, not the least interesting subject, that it is my business at present to advert to, relates to the opportunities offered by establishments of the nature of this Institution, in improving female education. "It is not," said Sir H. Davy, in propounding the plan of the Royal Institution, "it is not our intention to invite them to assist in our laboratories, but to partake of that healthy and refined amusement which results from a perception of the variety, order, and harmony, existing in all the kingdoms of nature; and to encourage the study of those more elegant departments of science, which at once tend to exalt the understanding and purify the heart."

It is somewhere said in the Rambler, that all appearance of science is particularly hateful to women; and that he who desires to be well received by them, must qualify himself by a total rejection of all that is rational and important; must consider learning as perpetually interdicted, and devote all his attention to trifles, and all his eloquence to compliment.

It is barely possible that such might have been the state of things at the middle of the last century; but the case is now widely different; and, in consequence of the diffusion of general knowledge and information that appears in all respectable classes of society, ignorance every where meets with contempt. In these observations it is very far from my intention to recommend the abstract sciences as part of female education, but merely to advise the acquisition of general information. Pedantry is at all times nauseous, but never so disagreeable as in female attire, where it is always indicative of the absence of the more estimable and useful mental acquirements.

Let us then indulge the hope, and exert ourselves for its fulfilment, that within these walls Science and Literature may establish a permanent and friendly intercourse with Commerce and Trade; that they may enter into a league against ignorance, pedantry, and prejudice, in defence of the true ends of knowledge; that their merits may be duly appreciated, and set forth with dignity and with truth; and that these means may be so directed to the improvement of the moral as well as the intellectual character, that "our Merchants may become as Princes, and our Traffickers the truly honourable of the earth."

ART. II. *Microscopical Observations on the Red Snow.* By Francis Bauer, *F. L. S. F. H. S., in a Letter to* W. T. Brande, Esq, *Sec. R. S., &c.*

Dear Sir,

ALTHOUGH I had heard various reports and opinions respecting that curious phenomenon, the Red Snow (discovered during the late Northern Expedition, under the command of Captain Ross, on the 17th of August, 1818, in Baffin's Bay, in lat. 75° 54′, N. and long. 67° 15′. W.) I had no opportunity of seeing it, until the 28th of February last, when I received a quart bottle full of the melted snow, for the purpose of ascertaining (as far as it could be effected by microscopical observation,) whether the red colouring matter were an animal or a vegetable substance.

I now venture to lay before you a detailed account of the mode and result of my investigation; and if you should deem it deserving the honour of insertion in the Quarterly Journal of the Royal Institution, it is entirely at your service.

After the bottle had remained at rest for eighteen hours, I found on examination that its contents consisted of perfectly clear water, having deposited a sediment at the bottom of the bottle, not quite a quarter of an inch in thickness (or in proportion to the water, as 1 to 34.) apparently consisting of an extremely fine powder, of a dark red colour.

Carefully uncorking the bottle, without disturbing its contents, I dipped a small ivory instrument into the clear water, and placed a drop, which covered a space of about a sixteenth part of a square inch, upon a plain glass; and bringing it under the microscope, I observed it to be pure water, on the surface of which were floating about 15 or 20 extremely minute organized spherical corpuscles, or globules, of different sizes, perfectly colourless and transparent. I repeated these operations several times, and found always the same appearances.

I then shook the bottle, in order to mix the sediment with the water, which was very soon effected, and the whole contents became tinged with a light crimson colour. Putting a small drop of this coloured water upon the plain glass, and bringing it within the field of the microscope, I observed some hundreds of similar globules, of various sizes, most of them nearly opaque, and of a fine dark red colour, all of which soon sunk to the bottom, but the transparent and colourless globules remained floating on the surface of the water.

These globules I could compare to nothing but either the pollen of some plants, or to the minute fungi of the genus *uredo*.

With this impression on my mind, I examined the subject more closely, and, employing stronger magnifying powers, soon found several individuals still adhering to their pedicles, the same as I have found in most species of *uredo*, and which distinguishes these minute fungi from the pollen of some plants.

As the water on the glass under the microscope gradually evaporated, I observed also the same granulated glutinous substance which always issues from those fungi when ripe, and which I believe contains its seed. When the water is entirely evaporated, and the globules become quite dry, they stick together in the same manner as all species of *uredo* do, and in that state they can hardly be distinguished in shape or colour from the *uredo fœtida*.

Having dried a sufficient quantity of these globules, I put them upon some hot iron, and the smell of the fumes proved also that they are vegetable matter.

The above experiments I repeated, with a sufficient quantity of the *uredo fœtida*, and the results were precisely the same; the ripe and coloured fungi sink to the bottom of the glass, or bottle, and form the same kind of sediment, and the unripe and colourless fungi remain floating; and when put, in a dry state, upon hot iron, the smell of the fumes is the same as that which is produced by the red globules.

It was at this stage of my investigation, and after I had ascertained the above facts, that I gave it as my opinion, that the substance which gives the red colour to the snow is not of animal origin, but a fungus of the genus *uredo*. This was on the first of March last, several weeks previous to the publication of Captain Ross's narrative of the voyage, and before I knew that any one else had investigated the subject, which I only learned when I read the accounts given in the publication; but at that time I had already pursued the subject further, and ascertained additional facts, all of which tended to confirm my first opinion; at the time when I expressed that opinion, I had only seen the fungi in a detached and loose state (see Figs. 1, 2, 3, and 4, in the annexed Plate,) but on the 14th of March, as I was pouring out a larger quantity of the contents of the bottle, I observed several flakes, of a jelly-like white substance, with many of the full-grown red fungi adhering to it, which, when brought under the microscope, proved to be the same cellular or articulate root, or spawn, which is common to most species of *uredo*, (see Figs. 5, 6, 7, 8, and 10.)

On the 16th of March I poured a considerable quantity of the coloured water into a large conical-shaped rummer, to obtain more of the sediments; when, after it had been standing at rest twenty-four hours, I found, on examination, that, although a considerable quantity of sediment had been formed, the inner surface of the glass, as far as the water reached, was entirely covered with a single layer of the red fungi. This appearance continued unaltered till the fourth day, when I observed the fungi were gradually losing their colour, and small flakes of the jelly-like spawn became evident in several spots on the inner surface of the glass; and after the glass had stood at rest three days longer, I found the fungi had entirely lost their colour, and the new-formed spawn had increased considerably; and on bringing a small portion of the substance within the field of the microscope, I found the white spawn the same in appearance as that which I found in the original bottle, and a great many very minute colourless young fungi were adhering to its surface.

After the glass had stood at rest another week, I examined another portion, and found the new spawn had not only considerably increased in quantity, but even the mark made on the glass where I scraped the first portion off, was nearly obliterated, being overgrown by newly-formed spawn, and the new fungi had nearly attained the ordinary size of full-grown fungi, but were still perfectly colourless, (see Fig. 6.)

I have since repeatedly examined the contents of the glass, but have not observed any material change. The increase of new fungi continued evident for about three weeks; since that time the marks on the glass from which the substance had occasionally been removed, remained visible and uncovered, and the fungi, accumulating in large clusters, detached themselves from the glass, and sunk to the bottom, without ever attaining the red colour, though the substance has now been exposed to the open air for the last ten days and nights. Hence it appears evident, that the new-formed fungi never come to perfect maturity; and that, when the seed of the primitive plant is exhausted, the increase ceases.

The original red, as well as the newly-produced colourless fungi, when left to dry, become both the same brownish gray colour, (see Fig. 7;) but if the red fungi, whilst fresh, are bruised and rubbed on the skin of the hand or the face, they form a pigment of the most bright vermilion, or red lead colour, which remains unchanged, even over night, and till it is washed off with soap and water.

The results of Dr. Wollaston's chemical analysis, published in Captain Ross's narrative, correspond also in every material point with those obtained by Tessier, in experiments made with *uredo fœtida*, and *uredo segetum*. (See *Traité des Maladies des Grains*. Par M. l'Abbé Tessier, p. 225-235.)

Having diligently ascertained the above facts, I feel now not the slightest hesitation in saying, that the substance which gives the red appearance to the snow is a new species of *uredo*, and for which I think the most proper specific name is *nivalis*.

There can be no doubt but this new species of *uredo* grows upon the snow where it is found; for it appears impossible that the substance could be brought from any distance by the wind, or any other means, to that spot in so great a quantity; for it is stated in Captain Ross's narrative, that the extent of the crimson cliffs is about eight miles; the sides of the hills on which it was found are about six hundred feet high; and he says, the party which he had sent to procure some of the snow "found that the snow was penetrated even down to the rock, in many places to a depth of ten or twelve feet, by the colouring matter; and that it had the appearance of having been a long time in that state." But it is not stated in how many places the party had been digging ten or twelve feet deep in the snow.

In a journal of the same voyage, published by an officer of the Alexander; in the account given there of the red snow, it is stated, p. 63. "This substance, whatever it may be, is very plentiful, on this part of the coast, the snow being covered with it in different places to a considerable extent. It is soluble in water, to which it gives a deep red colour, but, when allowed to settle a little, sinks to the bottom, leaving the water almost colourless. It is worthy of remark, that this colouring matter, be it what it may, *does not penetrate more than an inch or two* beneath the surface of the snow," *&c. &c.* This appears certainly more probable; however, it will be better to leave this little difference to be settled by the respective travellers.

Mr. Brown, in a very short note, published in Captain Ross's narrative, expresses an opinion that the plant might be a *tremella*; and quotes *tremella cruenta*, in the English Botany, Fig. 1800. That plant I have not yet seen in nature, but, judging from the quoted figure, as well as from the description, I am firmly persuaded it is no tremella, but most likely an uredo. The authors of the English Botany, in their description of this plant, say, "When examined with a microscope, it proves to be a congeries of extremely minute, pellucid, globular granulations, all equal in size."

They conclude their description with saying, "We are well aware that it can only rank as a *tremella* till more observations are made on the subject."

It is true all the species of *uredo* which I have hitherto examined, and those described by Persoon, are parasitical plants, growing upon other vegetables; but that I think does not prove that there are none that grow otherwise. I know at least one instance that these same parasitical plants can, and do, vegetate and propagate on other substances than living plants, for, in 1807, during my investigation of the diseases in corn, I put some barley and oat ears, which were partially infected with smut (which is the *uredo segetum*,) into brown paper, to preserve as specimens, in which, on examining them in about three or four months afterwards, I found the fungi had not only entirely consumed several of the ears, but had continued growing and multiplying on the paper, on which they had spread from the several spikets of the ears in distinct rays, of two or three inches in length, and the quantity of fungi thus produced on the paper is at least three times the quantity the original ears could have contained; these specimens are still in my possession. I have no doubt but that the *uredo segetum*, as well as the *uredo fœtida*, vegetate and propagate in like manner on the soil, it being a known fact that the purest seed-corn, sown on land which, several years before, produced those diseases, will likewise be infected, though, during the interval, no wheat or barley has been cultivated on that ground; and it is not probable that these fungi and their seed should have been lying in the ground inactive for several years; but their extreme minuteness, and their dark colour, renders it almost impossible to detect them on the ground; perhaps some future observations might ascertain these facts more decisively.

The method I have used to ascertain the real shape and size of these fungi, is that which a thirty year's practice and experience has convinced me to be the most simple and most accurate; and, in cases of such extremely minute objects, the only practicable mode, *viz.*, by means of a glass micrometer, in a Dollond's compound microscope.

The micrometer employed on this occasion, was a line of an inch in length, divided into 400 parts, which divides the square inch into 160,000 parts, or squares. On examination under the microscope, I found that four full-grown fungi, in a close line, occupy exactly the space of a $\frac{1}{400}$ part of an inch in length, (see Fig. 1 ;) therefore 1,600 of these fungi are required to form a whole inch in length. Hence the real diameter of an individual full-grown fungus of *uredo nivalis* is the *one thousand six hundredth part of an inch.*

In the annexed plate, Fig. 1, represents a $\frac{1}{160,000}$ part of a square inch, and shews that, in order to cover its whole surface, 16 fungi are required ; consequently, to cover the surface of an entire square inch, *two million five hundred and sixty thousand* such fungi are requisite.

The above $\frac{1}{160,0000}$ part of a square inch (Fig. 1.) being represented of the size of a whole square inch ; it is therefore magnified 400 times in diameter, and 160,000 times superficies, and every object represented within that square is consequently magnified in the same degree, *viz., four hundred times* in diameter, and *one hundred and sixty thousand times* in superficies.

The form and size of the fungi is ascertained, as above stated, by means of the glass micrometer, in a transparent state, and their colour, by placing them on white paper, and viewing them with a strong magnifying single lens, in an opaque state.

To afford an opportunity for immediate comparison, I have represented in the annexed plate, two well-known species of uredo, viz. *uredo fœtida*, which grows within the grains of wheat, and constitutes the disease known by the name of *smut-balls*, or *pepper-brand* (see Figs. 10, 11,) and the *uredo graminis*, which grows on the leaves of wheat and most grasses, and occasions the disease called the *red rust*, (Fig. 8, 9.) Those figures are magnified in the same degree as *uredo nivalis*.

FRANCIS BAUER.

Kew-Green, 25th April, 1819.

Explanation of the Plate. (*Plate* VI.)

Fig. 1. A $\frac{1}{160,000}$ part of a square inch, containing 16 full-grown fungi of *uredo nivalis*, magnified 400 times in diameter, or 160,000 times in superficies.

Fig. 2. Some young fungi.

Fig. 3. Some full-grown fungi, but larger than the usual, or general, size.

Fig. 4. A large sized fungus, in a colourless and transparent state, when it is seen that these fungi are neither recticular nor cellular, but the granular contents are in that state perceptible.

Fig. 5. A cluster of fungi of different sizes, on their spawn, as found in the original bottle.

Fig. 6. A cluster of nearly full-grown colourless fungi, on their spawn, as lately grown in an open glass in the house.

Fig. 7. A small cluster of full-grown fungi, in a dry state. All the above figures represent uredo nivalis.

Fig. 8. A cluster of the same fungi on their spawn.

Fig. 9. A $\frac{1}{400}$ part of an inch in diameter, sustaining 3 full-grown fungi of *uredo graminis*. In these fungi a hexagonal recticulation is perceptible.

Fig. 10. A cluster of the same fungi of different sizes and ages, on their spawn.

Fig. 11. A $\frac{1}{400}$ part of an inch in diameter, sustaining 4 full-grown fungi of *uredo fœtida*.

Every object in this plate is magnified *four hundred* times in diameter, and *one hundred and sixty thousand* times in superficies; and if the objects were contemplated as solids, they would be magnified *sixty-four millions of times*.

ART. III. *Additional Remarks relating to the Ægina Marbles, described in the Sixth Volume of this Journal. By* C. R. Cockerell, *Esq*.

I VISITED Athens with Mr. Foster, in 1811, and we had the good fortune to meet with a society of Germans, whose objects and pursuits were, like our own, chiefly directed to the remains of art. In examining the temples of Athens, with our lamented friend and companion, the Baron Haller*, some details, of singular interest and novelty, induced us to form the project of excavating the Temple of Jupiter at Ægina, for the purpose of ascertaining how far these might be found common to other remains of Grecian architecture, as well as for the general object of advancing our studies.

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* This estimable and ingenious man expired at Athens, after a short illness, brought on by exposure to the malariâ of the country. His virtues, and singularly amiable qualities, have rendered his loss most severe to his friends, and his death has deprived the world, in a great measure, of many valuable notices on Greek remains, which his long stay and unexampled diligence had collected. The portion of his labours in which I had a part,

Mr. Linckh, of Stutgard, joined our party, and in the latter end of May, we visited the remains, and pitched our tent under the platform on which the temple stood. An ancient cave immediately under the north-east angle of it, which doubtless served the purposes of oracular and other mysteries of the god, was now converted into the habitation of our servants, and for the conveniency of our encampment.

Being at some distance from the village, we provided ourselves with arms, and a Janissary from Athens; for the Saronic gulf is so infested with the Mainiot and other pirates, as often to deter travellers from risking a visit to so remote a spot.

We, however, formed a strong party, and watching by turns with a blazing fire, for which the woody sides of the Panhellenian Mount provided very amply, we were in little apprehension of interruption. Here we passed nearly twenty days in the delightful pursuit of this excavation, and we attained completely the object of our journey, in the restoration on paper, from the admeasurements we procured, of every detail of this ancient temple.

We had not expected the extraordinary result which forms the subject of this Memoir, for it could hardly be supposed that a period of at least 2,000 years could have passed, during which from the curiosity of travellers, even the hand of man, should have left these singular remains unnoticed.

The present proprietor, His Royal Highness the Prince Royal of Bavaria, has reserved the publication of the details of his statues on an enlarged scale, and as they are now placed in the Gallery at Munich, it is hoped that they will shortly appear with all the minuteness and attention due to such interesting subjects; the casts of them, however, which, by an agreement at the sale,

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is, however, in my hands, in consequence of an arrangement between us at the time of our separation; but the greater part are in the possession of H. R. H. the Prince Royal of Bavaria.

were to be furnished to the several former proprietors, are daily expected in England. The exertions of Mr. Foster and myself to acquire the originals for this country, are well known to those acquainted with the proceeding of the Committee of the House of Commons, on the subject of the Athenian Marbles.

The Æginetan statues furnish the only illustrations in our possession, of the heroic costume and armour, as described by Homer, Æschylus, and the earliest Grecian writers; and the great nicety of execution in the smallest details, corresponds perfectly with the exactness which the poets have observed in their description ; a minute and scrupulous attention is paid to each tie and fastening, and as if the whole had been offered to the severest scrutiny, the parts never seen, were equally furnished with exact resemblance of each particular detail, in the most ancient coins of Corinth, Sybaris, Posidonia, and the earliest Greek cities of Italy, as well as of Ionia, which were much earlier proficients in arts, than those of Greece Proper ; and in the vases of the most archaic style (commonly in black on a red ground) we trace the character which is developed and explained in these statues.

In Fig. 1 *, the right hand and wrist are restored ; the whole of the wrist, though in various fragments, was perfectly preserved. The person whom it represents has received a wound in the breast, apparently by an arrow, which seems to have been of bronze ; the incisure is deeply cut ; the right hand is endeavouring to extract it ; the attitude is singularly supported on the left arm, the hip, and right leg :—the countenance is smiling and unmoved ; the hair, waving regularly from the centre of the head, is curled in two rows with great exactness, and falls down the back in a long and broad mass. On the left and right shoulder are three small holes, by which fillets or ringlets, ornamental to the head, and in metal, were fastened ; the hair is, besides, bound with a fillet or string.

Fig. 2. Every part of this statue was found entire, and in its general form and anatomy, we are struck with the resemblance to nature : the stage of the art is, as already described, remarkably

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* See the Plates in the last volume of this Journal.

exemplified, and to make men as they are, was evidently the object of attainment*. The body is spare and short; the limbs are strong and full; the head (see Plate, No. 2,) is rather large: of the helmet there is no other example in antiquity, nor was the exact description of this species given: two pieces, γενειαστηρια, which covered the cheek were erected on the hinge, which is very exactly formed, the rest fitting the head, has a piece prolonged, which covered the nose and forehead, as far as the eyebrow. The φαλος, or rim, which carried the λοφος, or crest, was wrought in a separate piece, and was attached to the helmet at the apex; the crest retained signs of a red colour, hung down at the back: it was usually of horse hair ἵππουρις, or feathers; the helmet also was ornamented with painting in encaustic, and on the front, over the forehead, are several holes, by which something ornamental, probably in bronze, was attached: where the helmet covers the neck were also some holes, in which curls of lead were inserted: remnants of it were found in them, and in another fragment of a head, several ringlets, very exactly formed, were still remaining: detached curls in bronze have been found before: see the *Bronze Herculaneum*, tom. i. to v. 2 and 11; but these offer the first example of such a material. Across the breast, and over the right shoulder, are signs of the τελαμῶν, or sword belt, and his hand was wrought hollow to receive the spear, which was of bronze or other material, and might have been the εγχος, or καυλος, the long spear:—the other combatants, from their situation in the pediment, would only have used the δόρυ ὀρεκτον, or καυλιον προβολιον or missile short spear; and it is interesting to observe this detail of military tactic: the archer, unable to bear a shield, requires a constant companion and protector, and the long spear would be particularly applicable to such a purpose. The motion is momentary, and the angular position of the limbs is admirable, and singularly adapted to fill his place in the pediment: it has also a character of great energy, and contrasts well with the attitudes of the surrounding figures. It had no other support than at the feet and point of the knee, which were attached to a plinth let in at the top of the cornice. The shields are formed with extraordinary exactness in Parian marble, and seldom more than half an inch thick, though wrought in one piece, and in some instances solid with the arm and body: it is the Argive ασπὶς ενκυκλος; the τελαμῶν or handles were very nicely formed to the arm; the inside of them retained signs of red colour, and within a circle of the exterior, a blue colour was discovered in several, which, as a field, received, without doubt, the symbol adopted by the hero; on a fragment of one in the east front, we found in relief a part of a nymph.

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* Lysippus, who flourished about 200 years after this period, and when the art had made sublime efforts, held as a precept of the ideal, to make men as they seem to be, not as they really are.—Plin. l. 54. c.

No. 3. The head, the hands, the right leg from the knee, and part of the left, were restored. The costume is highly interesting; the body is covered with a leathern jacket (Σπυλας) which is tied by several strings on the left side, under the arm; two straps of the same piece pass over the shoulders, and tie on the breast; the arms are uncovered; the ζωστὴρ or μίτρα of brass in straps, in two thicknesses, covered the lower part of the body, and a small tunic, in very exact plaits, came below this, and appeared also under the arms: the quiver was found, and the manner in which it was evident, by the corresponding holes, that they were sustained at the left side, is very singular: the top of the quiver was pierced for the insertion of the heads of arrows in bronze or lead. From the action in the muscles of the arms of the remaining part of the figure in general, it was evident that he had just discharged the arrow. From below, such a position is remarkably happy in effect.

No. 4. This figure is of the most beautiful sculpture; the forms are elegant, at the same time that they are full of vigour. Except the head, which has been restored, every part is entire, and large portions of the shield; from the situation in the pediment, it is evident that the spear must have been short, and in the vases are several examples from which this has been indicated. The belt, and other particulars described in No. 2, are applicable to this also, and in the whole of this figure, by the most careful observation, no other visible support was perceived than its own balance on the feet, which were attached to a plinth inserted in the upper part of the cornice. But it is on No. 5, as the principal attraction in the picture, and on which the interest chiefly rests, that the sculptor seems to have dwelt with the greatest pleasure and attention: the body and limbs are of the utmost beauty, and with the greatest possible delicacy in the execution, there is a lassitude through every part very admirably expressed; it is at the moment of falling; the hand grasping the sword, still supports him, and the left bears the shield, though the hand has dropped from its handle: the head is of singular beauty, and though found in a separate fragment, and the neck so injured as to have spoilt the joint, it undoubtedly belonged to this figure; see Plate 2, No. 5. The helmet is thrown back, and seems falling from the head; the eyes and nose, and the cheeks of it were wrought entirely hollow, and disengaged from the head, in a manner that surprises by its boldness and delicacy; the hair is finished with the utmost nicety; and though the countenance, like the rest, is unmoved, no means has been spared to give an interest extraordinary to each part of this statue: the left leg is much bent, to admit those of the Minerva, and it was this circumstance, and the shortness of the left arm in the execution of the statue, in correspondence with the spot in which it was found, which persuaded me of its position in this part of the composition. Every part of this figure, though in pieces, was found. The whole of the weight is thrown on the left hand, which was placed on a plinth, as above.

No. 6. In this magnificent statue of Minerva, who, by her action, seems from Olympus to have just alighted to animate the combat by her presence, we have the most antique costume hitherto known to us. The form of the Ægis is singular, nor have we seen it before in sculpture, surrounded with the tassels, the noise of which was said to have dismayed her opponents: we know such a sort of appendage to have been in much earlier use, than the more usual one of the serpents. These were undoubtedly of brass, or some metal which has disappeared: they were fastened by rivets of lead, most of which still remained: the holes by which the Gorgon's head was attached to her breast were evident, and the whole of the Ægis was painted with scales in encaustic, the colour could not however be discovered: ἁλυσιδωτος, λεπιδωτὸς, φολιδωτὸς were the terms used for such ornament. It is very large, and formed a cloak and breast-plate, admitting the arms to wield the shield and spear. The former had an additional τελαμῶν or collar from the elbow to the shoulder, which attached it more securely, and this had also straps which passed round the body. The head bent forward, is extremely beautiful, (see Plate II. fig. 6.) The helmet is of a singular character, painted in encaustic, and enriched besides with ornaments applied, the rivets of which still remain; the φάλος is elevated from the head by a serpent; by the holes in her ears it cannot be doubted that she had ear-rings, the χοοτος or tunic is plaited with the utmost care, and the peplos hanging from her arms, is arranged with the same regularity in the front, and at the back; it forms two large plaits, from which others diverge in regular divisions. The feet stand obliquely, the motive of which was in part the inconvenience of placing the fallen hero before her; but more, I suspect, to resemble some famous Palladium; and the same position occurs frequently in the vases. Every part of this beautiful statue is preserved entire, and the buckler solid, and of the same block of marble with the figure.

No. 7. The legs only, and portions of the thighs, sufficient to show the position of the figure, were found in this instance; but the exact resemblance of their character with the corresponding one of the East, leaves no doubt of the intention of this figure.

No. 8. The whole of this is entire, except portions of the legs and the right hand. It is to be regretted (though it is one of the most striking proofs of the devotion of the artist) that the best view of this grand and majestic figure is turned towards the tympanum. A very distinguished character is given to the head (see Plate II. fig. 8.) as one of the most important in the picture. The helmet is of that kind termed γεῖσον; the hair and beard are very nicely arranged, and at the back a cap or lining is seen underneath; the loplos descending along the back, had a small stud left in the solid of the marble, at the back of the figure, for its security and greater firmness. The shield was of the same block with the rest, and is most surprisingly supported, by the thickness of the shoulder and arm alone. On the shield is indicated the field in which the symbol of the hero was painted, but of which no certain traces remain.

No. 9. None of these statues are more singular and novel than this; it is a complete Phrygian apparel; the ἀναξυρίδες, a tight dress of leather fitting the whole figure, to the ancles and wrists, was besides painted in scales with encaustic colours; the bonnet or mithra occurs frequently on medals and vases; but the singular form of it has never been so well understood, the back part of it descends on the shoulders, and two straps which occasionally came under the chin, were in this turned and tied behind the head. The hole in which the ringlets were inserted are seen all round; the jacket descends to the thighs, and is closed on the breast, and the pantaloons are under this, descending to the ancles. The ζωστὴρ sustains the quiver, which was found perfect. The action of the hands and manner of holding the string and arrow are explained in Plate 2, fig. 9; the manner also of drawing the bow-string to the breast, exactly as Homer describes it, is observable in all these archers. See Homer's Il. 8, v. 123.

In every view this elegant figure is one of the most graceful and pleasing in the group; except the point of the cap, every part was found entire. The position is bold, for it is momentary, and it is singularly calculated for the observer below. Except its plinth, it had no other support than its own due balance on the feet.

No. 10. The energy of this figure is admirable; though concealed by the shield, every part is finished with attention; the sword-belt is easily traced over the shoulders, but by the position of the right hand, it evidently held the spear. Except a portion of the head and the right foot, every part of this figure is preserved.

No. 11. This recumbent figure is also entire, though much corroded from exposure to the wet, having been found near the surface. The left hand is on the left knee, in which is seen a deep incision, as of an arrow; he does not seem to extract it, but seems to press it as if in suffering pain; the hair, like the corresponding figure in the left, is exactly arranged, and hangs down the back in curls; the same holes are seen on the neck as of ringlets, and the sword-belt may also be traced over the shoulders.

The two small female statues on the apex were found entire, except the heads and the left hands holding the pomegranate flowers; their feet, on a small plinth, were still attached to the ornamental pedestal on which they stand; we recognize in them the well known costume and attitude of the Ελπὶς of the Greeks, of which the various museums and coins furnish so many examples exactly similar in every respect, and in the most archaic style. Although various passages of ancient authors and the number of statues of this goddess, sufficiently attest her importance amongst the Greeks; yet we have no mention of temples to her honour in any instance of a similar application*. It cannot but appear, however, that while they are highly ornamental they are also singularly appropriate to the subjects beneath them, for while the battle is suspended Hope might still preside†.

In Plate II. the small female head belonged to corresponding figures in the East of a dimension somewhat larger; various fragments of them as traced were found, sufficient to prove their general similarity, though not enough to restore them even on paper. The hair, curled with great care, is confined by the *σφενδονη*, the ear-rings are cut in the marble. It will be observed also, that the apex, by the various fragments of it discovered, was on a much larger scale, corresponding with the proportionally greater importance, and the number of the statues and richness of composition and decorations in the East front.

We have various examples of ancient bas-reliefs, as well as passages † which represent Fortune as the companion of Hope. In the temple of Jupiter at Olympia, a victory on the apex was placed; it is possible these might have had the same signification, and it would seem that where Minerva takes a decided part,

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* See Museo Vat. vol. iv. Tav. viii. and vol. vii. Tav. xx. Visconti's description of the Candelabra, &c. in Museo Etrusco, Tav. xxvi.

† Theogn. v. p. 37, Vas. di Salviani, p. 71. and Antholog. lib. 1, cap. xxv. Nos. 2 and 3.

Victory would attend her; with the same propriety, Hope should be present while the contest is undetermined.

The acroteria on the apex in the West, as before observed, was found nearly entire, Its nice construction and manner of adapting it to the roof and tiles, and the exquisite perfection of every part of it excited our wonder and admiration; it is of Parian marble also. The griffins or chimera surmounting the angle of the pediment (see Plate II.) were found at each corner of the temple, and though much broken, fragments enough were found to give complete authority for their restoration in drawing, except the head, which is taken from the Teian medals; it was a portion of one of these which Chandler discovered in his hasty excavation at this temple, and mentions as the legs of a greyhound.

The lion's head attached to the extreme tile was found perfect, and in the blocking which carries the chimera was a sinking, corresponding with the thickness of the plinth to which the legs were attached.

It is hardly necessary to repeat, that the whole of the ornaments indicated on the several members of the cornice were painted on the marble in encaustic; as are the extreme tiles, forming the upper moulding of the pediment, and on the stone of which the whole temple was constructed, is a thin coat or varnish of very fine and hard plaster.

ART. IV. *On the Periodical Suspension and Renewal of Function, observable in the Human Body.* *By* J. R. Park, M.D.F.L.S. & M.R.I.

ON THE CAUSE OF SLEEP.

THE most remarkable instance of periodical intermission of function is that attendant upon sleep; and it may excite surprise in the minds of those who are not aware of the imperfect state of our knowledge of the animal economy, to find this familiar affection classed amongst those phenomena which the physiologist is unable to explain or account for.

That the nature and cause of sleep have never been truly ascertained, appears from the discordance of opinion that still prevails amongst the most eminent writers respecting the physical state of the brain which produces it.

How much our ignorance on this subject is to be lamented, may be readily appreciated by reflecting, that a disturbance, or morbid change of this affection, forms a prominent feature in many formidable diseases; and the physician cannot be supposed to possess an adequate knowledge of their nature, whilst he remains unable to account for one of their leading symptoms.

But the importance of the subject may be placed in a more striking point of view.

The operations termed mental immediately proceed from the brain, which is as much the organ of mind, as the eye is the organ of sight; and the state of the mental powers as much depends upon the condition of the organ of mind, as the sense of vision depends upon that of the organ of sight.

Now sleep, which is a temporary suspension of the mental faculties, is almost universally ascribed by physiologists to a peculiar state of the brain; but if the nature of that state, or of those changes which produce a periodical remission and renewal of activity in the brain be unexplained, it is evident that the laws are not yet ascertained, by which its function is governed. And it is not to be conceived, that the real nature and cause of morbid derangements, or aberrations of the mind can be known, whilst the knowledge of its healthy function is wanting.

The physical cause of sleep is a question then, which involves some of the most interesting problems in medical science; and its solution is, in fact, indispensable as a preliminary step to the consideration of others more immediately practical which will follow.

To expose the errors and inconsistencies of others is an ungracious, and far from a pleasing task; but where it is essential to the establishment of truth, as in the present instance, it cannot be dispensed with.

Sleep is described by most physiological writers, as a suspension of function exclusively confined to the organs of voluntary motion and mind. But the same authors, when inquiring into the physical change which occasions it, nearly all concur in ascribing it to a peculiar state of circulation in the brain.

Now circulation belongs neither to the class of mental nor voluntary functions, but is decidedly involuntary or automatic. If sleep then proceed from change of circulation, it originates in the vascular system; and the vessels being involuntary organs, it is surely inconsistent and erroneous to regard the remission of action which occasions it, as peculiar to mental and voluntary functions.

That sleep really does arise from change of circulation in the brain, as these authors admit, it is the object of the present essay to demonstrate; but at the same time to point out more precisely than has hitherto been done, the nature of that change; and moreover, to ascertain its cause, which these writers have not investigated.

The cause of this change of circulation will be found similar to that which produces periodical fluctuations of activity in other moving organs; or the subjection of the vascular system to the general laws of fibrous contraction. And the influence, which this change exerts over the mental faculties, will be seen to accord in every respect with the influence of altered circulation on other functions.

But before we proceed to the illustration of this doctrine, it will be proper to state more particularly the opinions of former writers respecting the physical cause of sleep.

This statement, as it regards some of them, must unavoidably bring into view a circumstance little calculated to inspire confidence in the accuracy of their reasonings; which is, that sleep is ascribed by different authors to diametrically opposite states of circulation; namely, by some, to too much, and by others to too little blood in the cerebral vessels.

It is singular, that these authors in ascribing sleep to altered circulation, should not have been prompted to investigate the cause of the periodical change of vascular action thus implied and admitted. Such an inquiry might have led to the detection of that important principle in pathological science,—the subjection of the vascular system to the general laws of muscular action.

And it might further have been expected, that, the connexion which in this instance was perceived, and tacitly allowed to prevail between the activity of the mental powers, and the state of circulation in the brain, would have directed the attention of physiologists to a more strict examination of the same connexion in other organs and other functions.

This examination would have led to the detection of the other equally important principle,—that, the state of every function immediately depends upon the actual condition of its capillary vessels.

Upon these two points, the foundation of pathological science may be said in a great measure to rest; and sleep, as well as every other suspension or remission of function, results from the operation of these laws.

To return to the opinions of former writers, the following are the views offered by the most eminent authors.

Sleep is ascribed by Cullen to collapse of the brain, by which is to be understood, as he explains (in his *Institutions of Medicine*, Part I. p. 95), a state of diminished mobility in the nervous fluid.

Darwin and Brown referred sleep to the diminution of excitability or sensorial power in the brain, which according to their views is expended during the day, and re-accumulated during sleep.

Haller, after shewing the probability of cerebral congestion, comes to the following conclusion: " Sleep, therefore, arises either from a simple absence, deficiency and immobility of the spirits; or from compression of the nerves; and always from the motion of the spirits through the brain being impeded. (See *First Lines of Physiol. Transl.* p. 285.)

Richerand disputes the doctrine of pressure from blood accumulated in the brain causing sleep; and, on the contrary, after enumerating the circumstances that denote a diminished circulation, he concludes, " that the brain falls into a state of collapse during its continuance; a proof that the quantity of blood carried to it is considerably diminished." (*Elements of Physiol.* p. 294, translation, London, 1807, 2d edit.)

Blumenbach takes a similar view, and considers that sleep arises from want of circulation, or diminished afflux of arterial blood to the brain. (See *Institutions of Physiology*, p. 178. transl. by Elliotson, 2d edit.)

Bichât referred sleep to an ultimate law of nature, establishing, as he conceived, the necessity for alternations of action and rest in the animal functions, whilst he maintained along with others, that the organic are exempt from this law. (See *Recherches Physiologiques*, p. 34.)

Whytt does not offer any explanation of the cause of sleep; but in his valuable treatise on the Vital and Involuntary Motions, he shews that the heart and other involuntary organs experience a diminution of sensibility during sleep, in consequence of which their action is retarded. (See *Vit. & Inv. Mot.* section 12.)

The most obvious objection to the doctrines of Cullen, Darwin, Brown, and others, which assume either a change in the quality, or deficiency in the quantity of the nervous power, is the suddenness with which this state is often removed; as when sleep and mental weariness are instantaneously dispelled by an impression on the mind. An objection that will not apply to the doctrine about to be submitted.

The inconsistency of representing sleep as an affection exclusively confined to voluntary functions, and yet referring it to altered circulation, seems to have been perceived by Bichât alone; who accordingly evades this dilemma by waving the inquiry into its cause, and referring it to an ultimate law of nature.

The facts that suggested this explanation, were too striking to be overlooked; and it is singular that they did not point out the evident subjection of involuntary as well as voluntary organs, to periodical change of action.

Whether sleep be ascribed to too much or too little blood in the brain; still, in either case, a periodical change of circulation is admitted.

If diminished circulation be deemed the cause of sleep, then the blood must be sent less forcibly to the head, to produce the change in question; and to account for this, the heart, which is also an involuntary organ, must be allowed to be subject to periodical diminution of action.

If increased fulness of the cerebral vessels be supposed the cause of sleep, then a diminished resistance or periodical relaxation in these vessels must be admitted to take place, in order to account for their fulness; for it will hardly be contended, that the action of the heart is augmented, or the impulse of the blood stronger during sleep than waking.

Thus, in either case, the origin of sleep is referred to the class of involuntary organs; and a periodical remission of their action must be admitted to occasion it.

In fact, if the doctrine about to be submitted be correct, it will be seen that there is some foundation for both these opinions; and it would appear, that the partial manner in which the subject has been viewed is the chief cause of the contrariety of opinion that prevails.

Sleep will be found to result from full and slow circulation in the brain; proceeding from a spontaneous relaxation of the cerebral vessels, occurring simultaneously with a retarded pulse, from diminished action of the heart.

The periodical recurrence of this state, results from the general laws of fibrous contraction, to which the heart and capillary vessels are subject no less than other moving organs. And the influence which this change of circulation in the brain exerts over the faculties of the mind, is similar to the influence of altered circulation in every other function.

In order to substantiate the truth of this doctrine, however, the same method of proof is called for, that was pursued in regard to the doctrine of hunger. In the first place, the cause alleged must be independently proved to have a real existence; and not be hypothetically assumed to explain the phenomena. Secondly, the phenomena must be shewn to accord completely with the cause alleged. And, lastly, any objections to which this explanation appears liable, must be fairly met and answered.

The cause assigned for the diurnal revolutions of sleep and waking, being the same as that to which the periodical returns of hunger and thirst were ascribed; namely, the alternate remission and renewal of activity in the circulating system, its reality has, it is hoped, been already shewn. But, since the periodical change of vascular action, is a fact not obvious at all times, owing to numerous circumstances that may disturb its regularity, it is of some moment to notice the statements of those who have been esteemed the most accurate observers of nature.

The names of Haller, Hunter, Whytt, and Bichât, will ever command respect; and each of these writers has noticed the diurnal fluctuations of the pulse. They concur in stating that it is generally somewhat languid and feeble in the morning; becomes fuller and stronger about mid-day; grows rapid and irritable towards evening, the usual period of febrile exacerbation; and at length becomes full and slow at night as sleep approaches.

Here then, we have the successive stages of activity in the vascular system distinctly marked, and these stages of action succeeded by a state of comparative relaxation or rest.

The circumstances, however, that may disturb or modify these changes are numerous, for the vascular system is subject to the influence both of corporeal and mental impressions. Diversity of occupation and pursuits; difference in habits of life, as to activity or indolence, temperance or indulgence; in short, any thing that operates powerfully on either mind or body, may so affect the pulse as to render it difficult to verify the uniformity with which these stages occur.

Moreover, in the state of perfect health the changes are too slight almost to attract attention, and have therefore generally escaped notice, except during indisposition, when the mobility of the vessels being augmented, their range of action is increased, and their fluctuations become more perceptible. In the state of fever, for instance, these changes become very conspicuous, and the utmost importance attaches to the observance of the period at which the febrile exacerbation recurs.

The reality of the cause being then apparent, its adequacy to produce the effects ascribed to it, now calls for consideration.

The influence which altered circulation in the brain exerts over the faculties of the mind, presents in fact nothing peculiar but is in every respect analogous to the effects of altered circulation in all other functions. As the power of motion and the faculty of sensation have been shewn to fluctuate with every change of circulation in their respective organs; so likewise the susceptibility for mental impressions, and the activity of the mind in the performance of intellectual operations, both vary with every change of circulation that the brain undergoes.

Thus, when circulation is impeded, as in the cold fit of an ague, the powers of perception are blunted, and the energies of the mind are impaired.

On the other hand, when circulation is much increased, as in the hot fit of fever, the reverse of this occurs; the susceptibility of impression is now rendered painfully acute, the temper becomes irritable, and delirium is apt to ensue from an uncontrollable rapidity in the succession of ideas.

Moreover, to complete the analogy, the influence which external agents possess in altering the circulation of the sentient organ, and which bodily exertion manifests in augmenting the circulation of the organs of locomotion, appears not less conspicuous in the effects of mental impressions on the circulation of the brain, and in the changes produced in this organ by the continued efforts employed in intellectual exertion.

Thus, for instance, as external irritation brings blood to the part, and causes redness of the surface; so the mental impressions of shame or anger, as formerly explained, determine blood to the brain, as indicated by the flushing of the face and redness of the eyes.

Again, as bodily exertion is attended with increase of circulation in the organs of locomotion; so long continued exertion of the intellectual powers causes a sense of weight and fulness in the head, which denotes congestion of blood in the organ of mind; and pain, after a certain period is equally apt to result from both.

If attentively considered, it will also be found, that exertion of the intellectual powers, exhibits successive stages, similar to those attendant upon bodily exertion, presenting the same fluctuations of activity, and connected with corresponding changes of circulation.

These variations of activity in the mental powers are most perceptible when the mind is long and vigorously exerted; but violent exertion is far from that which is most favourable in disposing to sleep, for reasons that will presently appear.

The successive stages of activity in the intellectual function, are marked as in other organs by symptoms of gradually increasing mobility.

In the first stage, the powers of mind are not fully developed, but with exercise the brain soon attains to the possession of its greatest vigour and activity. After these have been for a certain period energetically employed, the mobility of this organ, like that of others, is liable to become inordinate, and confusion of ideas is the result: and, eventually, the power of efficiently exerting the intellectual faculties, is partially impeded or wholly suspended; and pain in the head, as already stated, is the consequence of continuing this effort too long.

In short, this periodical change of function exhibits similar symptoms in the brain and in other organs; and appears connected with the same changes of circulation, as formerly pointed out. The effects of these changes only are variously manifested in different parts; in the organs of sensation, by change of sensibility; in those of motion, by change of mobility; and in the organ of mind, by change of the mental faculty.

Although the successive stages of mental activity are most distinctly marked, when the mind is long and vigorously exerted, yet the state of circulation thus produced, is by no means that which is most favourable to the production of sleep.

This condition of the mental faculty was stated to proceed from a spontaneous relaxation of the cerebral vessels, occurring simultaneously with a retarded pulse from a similar remission of action in the heart.

Now in promoting this general relaxation in the capillary system, the increase of circulation attendant upon immoderate exertion of mind is no way favourable. On the contrary, as restlessness and pain in the limbs result from excessive bodily exertion, so over-exertion of the mind produces wakefulness and pain in the head.

The changes that result from violent exertion, may be regarded indeed as bordering upon a morbid state from the pain liable to attend them; whereas that degree of exertion which is moderate and healthy, unaccompanied by inordinate determination to the head, and occasioning no uneasy sensation, alone disposes to sleep, for the following reasons:

In all moving organs, the state of action, as was formerly shewn, is succeeded sooner or later by a state of comparative relaxation or rest.

In the voluntary organs, the uneasy sensations which arise from over-exertion prompt us to discontinue our efforts in time; but in the involuntary organs, over which the influence of the will does not prevail, this remission of action is spontaneous.

And accordingly, like other involuntary organs, the capillary vessels at stated periods shew their disposition to spontaneous relaxation; as seen in the swelling of the lower extremities towards evening, in the flush of the face, and the redness of the eyes that accompany drowsiness; a change of action in the vessels, analogous to that which occurs in the muscular fibres of the stomach after repletion, or which was shewn to occasion the spontaneous suspension of hunger upon fasting longer than usual.

Now the exertion which disposes the capillary vessels to take on this state of relaxation must be moderate in degree; for over-distension produces the same effect in them as in other organs, or it occasions resistance and not yielding; as seen in the stomach for instance, which yields to pleasing impressions on taking food, but is roused to resistance by those which are displeasing, or by excessive repletion, and then eructations, nausea, or vomiting is the consequence.

In like manner impelling the blood too forcibly into the capillary vessels rouses them to resistance, and keeps up active circulation; as appears by the increase of vascular action in local inflammation: whilst the unfavourableness of accelerated circulation in disposing to sleep appears from the wakefulness attendant upon inflammation of the brain; and from the absence of sleep, which often continues for whole weeks during the active stage of insanity.

While increasing the stimulus of distention seems to prevent the spontaneous relaxation in the capillary vessels; the partial abstraction of that stimulus appears to promote it; and hence the simultaneous remission of action in the heart, which causes a retardation of the pulse at night, contributes to that effect; and accordingly sleep appears to proceed from the conjunction of these causes, producing full but slow circulation in the brain.

The proof of this, however, can only be rendered complete by a general survey of the symptoms attending this state, the causes that promote it, and the means that prevent or remove it.

To return, then, the symptoms present must first be shewn to indicate the existence of this state of passive congestion, which they clearly do.

The relaxation of the capillary system during sleep, as already stated, is a general and not a local change; but as the faculties of the mind, and the powers of voluntary motion, are most conspicuously affected, it is in the organs subservient to these functions, which are the brain and spinal chord, that evidence of this change is particularly called for.

Among the circumstances that denote this state of the brain, one of the most obvious and familiar is a symptom usually preceding sleep; to wit, a certain degree of flush in the face. Now this being unattended with any increase in the impulse of the blood, can only be referred to relaxation of the vessels; and the contiguity of the vessels of the face to those of the brain affords a presumptive argument, that a similar change takes place in both.

But a more decisive indication of this state of the cerebral capillaries presents itself in the appearance of the eyes, which acquire a manifest degree of redness as sleep approaches, and are sometimes so completely transfused with blood that their vessels appear as if injected. Since the eyes derive their principal supply of blood directly from the brain, the changes of circulation in the one, may be fairly inferred from those of the other, according to the laws of vascular sympathy, as formerly pointed out.

While the cerebral vessels thus appear to take on a state of relaxation, it is reasonable to expect that those of the spine should participate in the change. For the spinal marrow, though physiologically distinct from the brain in regard to function, is yet when anatomically considered, a part of the same organ, or a prolongation of the brain.

As the situation of this organ precludes the possibility of any visible demonstration of the changes it undergoes, we must look to its function for evidence of their existence, and here they appear sufficiently evident.

It is an admitted fact in pathology, that undue pressure in the spine, is capable of paralyzing the voluntary muscles; and morbid increase of circulation in this part, causing excessive mobility, was shewn in treating of vascular sympathies to be the most probable cause of the convulsive affections termed chorea and tetanus.

If then the vessels of the spine pass through the same periodical changes of circulation as those of the brain, corresponding fluctuations of function should be observable in the organs dependant upon the spine, or those of voluntary motion.

Now the only voluntary muscles, which are constantly and uniformly exerted throughout the day, and which are therefore diurnal in their stages of action, are those which support the head, the lower jaw, the eyelids, those of the trunk, and the muscles of respiration. These although termed voluntary, partake of the nature of involuntary organs, and continuing in action many hours together, they belong to that class in which tone and permanency of contraction predominate rather than mobility. It is therefore to be expected that this character will prevail through their different stages of action.

That stage of action which immediately precedes relaxation, or the third stage of activity, is marked by a tendency to inordinate mobility, or spasmodic action; and accordingly at this period such a tendency is evinced by the affection of those muscles that constitutes yawning and stretching, which clearly appertain to the nature of the tonic spasm, and are the frequent precursors of drowsiness.

This tonic spasm being semi-voluntary, may either be considered as an instinctive effort to obtain relief from an uneasy sensation in the organs, or as the spontaneous result of the spasmodic tendency that denotes the approach of fatigue.

Similar also in its nature is the full inspiration which often accompanies a yawn, being somewhat different from a sigh, and less like an effort to obtain relief from accumulation of blood in the lungs, than like a spasmodic expansion of the chest, from the muscles of respiration partaking of the same spastic tendency that affects those of the jaw in yawning.

The next change of function that takes place in these organs, most unequivocally betokens the presence of the stage of fatigue, and the tendency to spontaneous relaxation. The eyelids now close, the head can no longer be held up, but keeps falling forward, and the muscles of the back are so weary, that we are unable to sit erect without pain. In short, a temporary paralysis prevails, an effect which congestion in the spine is well known to be capable of producing; and that this is its cause, in the present instance, will be rendered further apparent by the consideration of the means that promote this state.

Amongst the causes that promote sleep one of the most conspicuous is the recumbent posture, which favours its accession in two ways. In the first place, it withdraws from the heart the principal stimulus that excites it to action, namely, the distending force of the column of blood descending from the head, estimated by Hales, in his Statical Essays, at four or five pounds; the removal of which, promotes retarded circulation, by allowing the heart to relax. And secondly, the horizontal posture promotes sleep, by producing permanent and moderate congestion in the brain and spine, upon the common principles of gravitation, when these parts are placed on a level with the rest of the body; and thus the conjunction of causes favourable to sleep is effected.

A moderate degree of exercise during the day is well known to render sleep sounder at night; and according to the principle that the subsequent relaxation of vessels bears a relation to the degree of their previous exertion, it is easily explained how this becomes a predisposing cause to sleep.

Sleep is promoted by most causes that excite a pleasing sensation; which have a tendency to produce relaxation of vessels, upon principles explained in treating of corporeal impressions; provided always that these causes be applied when the vessels are predisposed to this state of quiescence. Thus after exercise, especially in the open air, and in frosty weather, sleep is promoted by a warm fire, a hearty meal, and a few glasses of wine. When the vessels have not been disposed to rest by previous exertion, exhilaration is the usual effect that results from these causes, instead of sleep.

The darkness and silence of night are evidently conducive to the production of sleep, and apparently owe their influence to the abstraction of stimulus, or the removal of all external impressions, which are calculated to keep up active circulation.

Opium and some other drugs have a powerful effect in promoting sleep; and their operation well accords with the views here offered.

Whether their primary effect be to accelerate or retard circulation, has been a subject of controversy; but its decision is immaterial to the present question, since it is allowed that their ultimate effect is to retard the pulse; and it is then, and not till then, that sleep is produced by them.

The reason why extreme cold is productive of lethargic torpor, may be accounted for without inquiring into its physical influence and mode of operation. Like opium it retards the pulse in a remarkable manner, and this alone is sufficient to account for its influence in promoting sleep.

It is, however, probable, that cold and opium act upon somewhat different principles; opium disposing the vessels to relax by deadening their sensibility; whereas cold, though it also deadens sensibility, appears further to obstruct circulation by constricting the vessels and impairing their power of action.

Whilst the constriction of vessels on the face and surface impedes circulation and retards the pulse; the blood driven inwards promotes at the same time internal congestion in the head; and thus the conjunction of the causes favourable to sleep is effected by extreme cold.

Physical causes act mostly upon distant parts, and extend their influence to the brain through vascular sympathy; but mental impressions act directly upon the brain itself, and their operation becomes therefore a question of greater interest.

Now the impressions most likely to produce drowsiness, when the cerebral vessels are disposed to rest, are such as engross the attention without exciting any lively interest; for by thus preventing the mind from occupying itself with subjects really enlivening, they actually produce the abstraction of stimulus.

Such is, accordingly, the effect of reading an uninteresting book, or listening to a long dull story. In this state of mental weariness, the obligation to make the effort increases its irksomeness; and, as a wearied traveller, at the prospect of a long and dreary road still before him, becomes more sensible of fatigue, and, feeling his strength unequal to the effort, sinks under the bare apprehension; so the mind, when weary, often sinks at the anticipation of a long and painful effort of attention.

Yet the failure of mental activity, like the fatigue of the limbs, does not proceed from actual exhaustion of nervous energy, or from a change in its properties, for let an adequate cause be presented, and the attention is presently awake again; spontaneous relaxation subsides; circulation is renewed, and the activity of the mind restored. Thus the analogy is complete between the phenomena of mind and those of loco-motion. Nor is this surprising, since they proceed, as before stated, from different parts of the same organ, the spinal marrow being strictly a prolongation of the brain.

Among the mental impressions that dispose to sleep, grief may be enumerated as one which causes, at least, a heaviness or torpor of the mind. As it was shewn that this emotion has a direct tendency to produce relaxation of vessels and congestion of blood in the head with impeded circulation, nothing farther is required to prove its coincidence with the foregoing principles.

It yet remains to be shewn, that the means which retard or prevent sleep are calculated to remove this congestion in the brain, or to prevent spontaneous relaxation of its vessels by keeping up active circulation.

How sleep is prevented by actual pain, which was shewn to excite the vessels to contraction, needs no explanation. But many internal causes of irritation are not attended with sensible pain, yet equally disturb sleep, by keeping the vessels in a state of active resistance, and preventing their spontaneous relaxation from taking place. Such, accordingly, is often the effect of disease in internal organs, as the lungs or the liver, which is frequently unattended with painful sensation.

Certain substances, termed narcotics, as coffee or green tea, when taken into the stomach, create wakefulness. That they also quicken circulation is well known, and this sufficiently accounts for their preventing sleep.

The operation of mental impressions, which retard or prevent sleep, must be evident from what has already been offered.

As grief disposes to sleep, and creates a heaviness by causing circulation to languish, and by promoting congestion in the head; so joy which has an opposite tendency, and was shewn to operate by increasing vascular mobility, occasions wakefulness.

Fear, which is the apprehension of pain, acts in the same way as pain itself, or excites direct contraction in the cerebral vessels as formerly shewn, and has, consequently, the most decided influence in preventing sleep, affording a striking illustration of the principle in question.

In short, the symptoms present, the means that promote, and those which prevent, sleep, all concur to prove, that it proceeds from full and slow circulation in the brain, produced by the spontaneous remission of action in the cerebral vessels, simultaneously occurring with a retarded pulse from diminished action of the heart.

The objections that may be urged against this doctrine yet remain to be considered; and these will most probably be drawn from the morbid state.

Thus, it may be said, if slow circulation be essential to sleep, it should never occur in continued fever, when the pulse is always quick.

In reply to this objection, it must be observed, that the terms quick and slow are used relatively and not absolutely. A pulse that is quick to one person may be slow to another; thus, children have naturally a quicker circulation than adults, and often sleep with a pulse above an hundred. So a person in fever may obtain broken and interrupted sleep with a pulse much quicker than is natural in health; a remission of action, with a certain degree of congestion in the cerebral vessels being all that appears requisite to suspend the activity of the mental function.

In the weakened state of vessels accompanying fever, congestion is readily produced; but whilst active circulation continues, delirium and not sleep is the consequence. When active circulation abates, and simple congestion remains with retarded circulation, lethargic torpor then supervenes; and, accordingly, contitinued fever most frequently terminates in this way.

If the recumbent position be favourable to sleep, by promoting moderate congestion in the head, why, it may be asked, do some persons sleep better sitting up than lying down.

This effect may proceed from two causes, namely, weakness in the impelling power of the heart, or in the resisting power of the vessels; which will operate, however, in different ways. Failure of activity in the impelling power, by disposing the heart prematurely to relax, will retard the pulse, and promote sleep in the sitting posture; whereas, weakness in the resisting power, by rendering the congestion inordinate, when the head is laid low, may rouse the cerebral vessels to resistance, and, for a time, prevent sleep in the recumbent posture.

The constitutional causes most conducive to this effect, are the plethoric habit, and great corpulency, circumstances which confirm this explanation. In persons of this description, circulation, at all times laborious, is particularly obstructed in the sitting posture by the tightness of the clothes, and the unequal pressure of the seat, and the heart thereby sooner wearied; whereas, the sudden removal of these obstructions, by taking off the clothes and lying down, throws the blood more abundantly towards the head, and promotes inordinate congestion, and thereby for a time, renews active circulation, and prevents sleep.

It is not improbable, in the present imperfect state of pathological science, that difficulties will occur in considering the morbid states of sleep, which the doctrine laid down may at first appear inadequate to solve. But it is to be observed, that objections are not valid which derive their force merely from our gnorance of those morbid affections; since, it is not impossible that, were their nature thoroughly understood, they would be found to confirm rather than refute the reasonings advanced.

Some of the phenomena of sleep are supposed to fall within the province of the metaphysician rather than that of the physiologist. Of this number is

DREAMING.

The attempts, however, that have been made to explain its nature, without due regard being had to the physical state of the organ that occasions it, are not very satisfactory.

Mr. Dugald Stewart, in his explanation of dreaming, assigns as its cause, what is only one of its leading symptoms, and that by no means an invariable one, namely, the suspended influence of the will over the association of ideas, and the organs of voluntary motion.

The influence of volition, far from being invariably suspended during dreams, is often actively exerted, not only in the voluntary association of ideas, forming connected trains of reasoning, but even in the employment of our organs of speech and voluntary motion; as in somnambulism, which is certainly a species of dreaming.

Habit, which Mr. Stewart says, may produce connected associations that appear like reasoning, does not afford an adequate explanation of these effects; for habit can only produce the repetition of trains of thought that have actually passed through the mind while awake. But in dreams new reasonings often arise out of circumstances that had never occurred before, as in the following instance:

A gentleman, who had recently returned to Ireland from visiting some friends in England, dreamt that he was again in the midst of the friends he had left. But the circumstances of his return arising in his mind, he was puzzled to reconcile these recollections with the scene before him; and endeavoured to prove to himself, that he had actually returned by recalling various particulars of his departure and voyage home; until he convinced himself of the truth. On the other hand, he was still contradicted by the evidence of the scene around him; and remembering that false perceptions or delusions of this sort attend insanity, he inferred, that he must have become deranged, until the alarm awoke him.

Now the delusion which occasioned this reasoning could never have occurred before while he was awake, and therefore the reasonings founded upon it could not be a repetition, or the effect of habit.

But farther, somnambulists, who are certainly dreaming, are very commonly found to answer rationally when spoken to, and often hold conversation for a considerable time; which cannot be referred to chance or repetition, nor explained without admitting the partial exercise of reason and voluntary association.

Instead of being wholly suspended, the will, like every other faculty of the mind, seems to be only partially impeded during dreams; and the reason of this is to be sought for in the physical condition of the mental organ.

This peculiar state of the mind consists in an imperfect exercise of the cerebral function, owing to the obstructed or oppressed state of circulation in the brain already pointed out.

Dreaming occurs at the commencement of sleep, when the mental function is partially impeded, and still more frequently at its termination, when that function is not yet perfectly restored; but is attended in each case with somewhat different circumstances.

As drowsiness approaches, and the effort of attention becomes fatiguing, the eyelids are suffered to close, and the observance of surrounding objects now no longer serving to admonish the judgment, the train of ideas is left to the guidance of chance or imagination, and soon creates fortuitous or incongruous associations, which constitute our dreams.

In this state persons forget where they are, or fancy they are still holding conversation; whilst the organs of speech are not actually employed, more because the mind is inconscious that they have ceased to be exerted, than from an inability to exert them.

The dreams that occur just before waking are somewhat different from those that take place on falling asleep; they are generally more connected and more vivid, for the following reasons:

The activity of the brain is now renewed by rest, and the current of our thoughts flows more freely; but still the suggestions of fancy are not corrected by the observance of surrounding objects, while the avenues to the external senses yet remain closed; and thus the train of ideas may still be incongruous.

Our morning dreams are more connected at one time than at another, which seems to depend upon the more or less perfect renewal of circulation in the organ, when some accidental cause of disturbance sets the mind at work again.

Another circumstance that may render our dreams more connected, as suggested in Dr. Wilson's Treatise on Febrile Diseases, is the employment of language to embody our thoughts; for though words be not actually uttered, yet the lips are often faintly seen to move, and the effort may be feebly made, and occupy nearly the same time as if they were; thus serving to restrain the rapid succession of ideas, and render them more connected. Without some check of this kind, in the renewed activity of the mind which now prevails, a whole history of fire, thieves, or murder, may be dreamt during the creaking of a hinge, or the opening of a door.

If the suspended influence of volition be inadequate to explain the phenomena of dreaming in general, without taking into account the physical state of the organ; still less is it capable of explaining the production of that most distressing species of dream, termed the night-mare or

INCUBUS.

This affection is so evidently connected with a peculiar state of circulation, that it seems to admit of explanation in no other way.

That the character of our dreams is much affected by external impressions, and internal feelings, is a well-known fact: thus in a windy night we may dream of being at sea, a hail-storm may suggest a dream of being in battle, or flashes of lightning make us dream that the house is on fire. In like manner, uneasy internal feelings are apt to produce unpleasant or frightful dreams, such as occur in the night-mare.

A sense of oppression is felt on the chest, which frequently suggests the idea of being held down, and the alarm thus excited sufficiently accounts for the frightful images presented to the mind, which are common to the affection in question.

The cause of the oppression on the chest is the point that remains to be ascertained; and the principles before explained lead to the inference, that undue congestion of blood in the spine, impeding the action of the intercostal muscles, and preventing the free expansion of the chest, is the most probable cause of the sense of tightness and oppression that is felt there.

The circumstances that most frequently produce the night-mare, such as indigestion, a heavy supper, and lying on the back, from their aptitude to occasion congestion in the spine, strongly confirm this conclusion: while, on the other hand, fear, which was shewn to excite the vessels to contraction, instantaneously dispels this affection, by removing the congestion, with the first struggle that is made; and thus farther corroborates the reasoning.

Another species of dreaming is that called

SOMNAMBULISM.

In this state, the mind is still in a dream, intent upon some imaginary purpose, and the external senses are imperfectly restored; but the faculty of speech and the power of locomotion are freely exerted.

In such a state, persons will not only answer questions rationally, but are frequently known to unlock drawers, open doors, walk out into the air, or sit down to write letters, being unconscious all the while where they are, or that they have got out of bed, and are without their clothes. If suddenly awakened out of this state, surprise or great alarm is the consequence of the immediate renewal of perfect consciousness.

The physical cause of this singular affection appears to be an irregular distribution of blood in the sensorium, or some local congestion that impedes the uniform and simultaneous restoration of the corporeal and mental faculties.

From the principles already established, it may be inferred that the spine is not in this affection, as in incubus, the chief seat of congestion, but some part of the brain itself; for the mental faculties are evidently more obstructed than the powers of locomotion.

Moreover the moral causes that are often known to occasion this affection, such as mental uneasiness, or some secret sorrow preying upon the mind, confirm this inference, from their liability to produce this state of circulation.

Grief was formerly shewn to promote congestion of blood in the brain; and its continued operation is therefore well calculated to impede the uniform and equable renewal of circulation in different parts of the sensorium.

It is true that grief is not the sole cause, and moreover that a tendency to this local congestion, when it has first arisen from accidental causes, may in time become habitual, like that which occasions epilepsy; but where frequent repetition has not rendered it constitutional, mental uneasiness is known to be its most usual cause, and strongly confirms this view of its nature.

Thus sleep, with all its attendant phenomena, seems to depend upon the periodical changes of circulation that take place in the organs of mind and voluntary motion.

These changes are not, however, confined to the organs of mind and voluntary motion, but extend to all parts. Thus every function throughout the animal economy has its periodical remission and renewal of activity; and this change in all of them is ultimately referable to the same causes, namely, their dependance upon the state of circulation, and the subjection of the circulating powers to the general laws of fibrous contraction.

ART. V. *On the British Museum, and on Collectors.*

IT is time to inform the Public that they have lost many treasures of collections in literature and in art, or suffered by their removal from the spot most congenial to their existence for national purposes, either from some apparent indignity incurred by the possessor, or, what is still more to be regretted, from an ignorance of the nature of our great national repository, the BRITISH MUSEUM. After the irreparable losses suffered of this kind by the most enlightend men in the kingdom, who are the students or men of letters, resident in the metropolis, it becomes desirable to revise and to promulgate the constitution or laws of the Museum. Not only is the glory of the nation concerned in concentrating in its own collection the accumulated treasures of the curious, who are desirous of bequeathing them for public utility; but a higher motive exists that such rich donations should not be lost, or circumscribed in their use, as they are when in a state of dispersion, imprisoned in obscure recesses, or exiled from their natural atmosphere. The progress of human knowledge itself will be accelerated, when the student discovers, in one sacred spot, all that human industry can afford to facilitate his researches, and to offer to his meditations; and such an institution only is worthy of a great nation. It is due time to quiet the fears, or to direct the caprice of those generous collectors, who give a wrong direction to their noble passion; whatever they bequeath to the nation should be held as a hallowed deposit, to inspire them with confidence that the undisturbed existence of collections, which they have created with so much fondness, shall be reserved in perpetuity for those congenial spirits among their successors, who will carry on an unbroken line of knowledge from age to age.

Hereafter may again arise some munificent collector, a GOUGH, a FITZWILLIAMS, a BOURGEOIS, and a HUNTER, as we have had a Bodley, and a Harley, a Sloane, and a Cracherode. Of the first four of these eminent collectors the British Museum has lost the benefit of their collections, built up, like mighty edifices, by the rare opulence and knowledge of the individuals, in such different departments in learning and art. Yet these were originally designed by the possessors to round more perfectly the circle of human acquisitions, and to have been preserved for the nation in their own repository. The motives which occasioned these rich donations to be lost to the nation in their present insulated state, were not, indeed, always honourable to their possessors, nor sometimes to ourselves. We may, perhaps, be surprised to detect men of the most enlarged spirit acting from little personal motives, even in deeds which are accompanied by the very grandeur of generosity.

GOUGH, whom we may call our English Montfaucon, for his splendid *Sepulchral Monuments of Great Britain*, and his *Camden's Britannia*, of all men best knew the national importance of the British Museum; and, of all antiquaries, none more regretted the imperfect supplies of knowledge which had hitherto entered into the national library. A perfect collection of topographical history was the costly labour of his life, and he always signified that it should never be dismembered; nor did he omit hinting, that there was but one place where the history of our country could be appropriately found, to be always at hand, the library of the nation. Among the honours which one of his fortune and taste had set his heart on, was that of becoming one of the trustees of the British Museum; this honorary title was, as he said, the blue riband of literature. But GOUGH was a man of irritable and sullen habits, and one ever liable, in any place, to find an enemy rather than a friend. The honour he desired he never could obtain; and, though he was so magnanimous as to persist in his resolution, of never separating his collection, he was mean enough to indulge his personal pique before the public service he had proposed in his happier hours. He either revoked his former bequest to the Museum, or gave it a new direction to the university of Oxford, where, although it is deposited in "the antiquaries' closet," that land of the Latins can seldom be congenial to the Gothic story of British antiquities.

Such was the petty rancour of this celebrated antiquary; but when, on a similar occasion, we find the same irritability influencing the stronger mind of SELDEN, we must forgive so inferior a one as Gough's, while we shrink into our little selves in detecting the alloy of humanity.

SELDEN had formed one of the most curious libraries in Europe, and, even at that day, it was valued at several thousands of pounds; it was the intention of this great man to have left it entire to the university of Oxford, for we had then no national library but the Bodleian. Having occasion for a manuscript which belonged to the library, they demanded of him a bond of a thousand pounds for its restitution; nor was this demand so unusual as it appears; I have seen several bonds of this nature, with the signature torn off, which had been executed by the historian Strype, who, when he borrowed a manuscript of Sir Robert Cotton, always pledged a bond of one hundred pounds, and, when he had two together, the bond was doubled. Yet the feelings of SELDEN were of such morbid delicacy on this point, as if his honour had been questioned, that in a moment of passion he struck out that part of his will by which he had bequeathed his library to the university, declaring "they should never have it." The termination of this affair was highly honourable to Sir Matthew Hale and the other executors. At first, having hesitated to give up the treasure, they afterwards resolved on it; because, said Sir Matthew Hale, "we ought to be the executors of Mr. Selden's *will*, and not of his *passion*." It is to be wished that such bequests as Gough's, and some which I shall mention, had found executors as mindful of the honour of the deceased, and the love of the Public.

I have heard that the late Lord FITZWILLIAMS, having determined to deposit his magnificent collection of prints with some public institution, for this purpose called at the British Museum; but, neither addressing himself to a proper officer, nor intimating his design, crudely inquired, whether the British Museum ever sold its duplicates? To a common-place question could he expect any other than the simple answer he received, that they sometimes did. On which, turning away in scornful silence, he deprived the Museum of an unique collection still so much wanted there. He bequeathed it, with the addition of one hundred thousand pounds to build a gallery, to the university of Cambridge, where, if they are preserved from mouldering, is all that the nation can reasonably expect;—from daily use, and from all the artists and lovers of art, they are safely locked up. They are of no use to the nation, and scarcely ever, but by the most painful favour to the individual. The fine collection of pictures of the late Sir FRANCIS BOURGEOIS, which he received as a heir-loom from a celebrated collector, I know was designed by him for the British Museum; but, whether from a deficient energy among its officers, or merely from the caprice and weakness of Sir Francis's character, he imagined himself somewhat slighted in a sort of treaty respecting the donation, awkwardly begun, and unhappily conducted; he too was frightened away by the notion that the trustees reserved to themselves the liberty of disposing of them hereafter, as the duplicates had scared away Lord Fitzwilliams. Long he wavered, and could not fix on any public institution for the preservation of his pictures; when a mere accident, and a very foolish one, determined the fate of this precious though small collection. Dining at Dulwich college, a place ridiculously designated as a college, and four or five persons as ludicrously, I think, termed the fellows, influenced by the hilarity of a social glass, he was invited by a very companionable man, whose good humour was never spoiled by connoisseurship or the fine arts, to leave his pictures to them. They had a lumber-room darkened by the slips of windows of the age of Elizabeth, which, with these pictures on the walls, he imagined might assume the honours of a gallery. The imbecility of the donor instantly consented; he however left an insufficient sum to build a gallery, to save the pictures from the Elizabethan lumber-room; and the result is, that all these old masters have been sent out of town into perfect retirement, to encumber, in various ways, a society of four or five unhappy and unpicturesque monks.

In the instances which I have adduced, the errors appear to originate in the folly or caprice of the noble donors; but it is evident that their intentions were patriotic, and that, had they met the fostering zeal of more active attention to assist them to develope their designs, these treasures of learning and art had at this moment been combined in our national repository; our gallery of antiques had also presented to the students the charm of picture; our small print closet, whose iron door is now so heavily unlocked, and not easily entered, had opened for them the portfolios, which alone can afford the materials for the history of engraving through all its eras; and our library had supplied to the antiquarian and historian, many a precious volume which may be now only to be found in the corner of " the closet at Oxford."

But this has not been all the evil. The eyes of our ministers have not always been opened to these national designs; their value has not been acknowledged because it has not been comprehended; and great collections have been suffered to be broken up and to be dispersed, which a moderate price would have secured, or even a small favour conceded to the possessor. One of the most memorable examples of this fatuity and ignorance is still fresh in our recollections; the late Dr. William HUNTER having formed a rich collection of manuscripts, medals, natural history and anatomical preparations of infinite value, designed this entire labour of his life for the nation; warm with this noble purpose he addressed the prime minister to allot him a space of ground in the metropolis for the erection of "The Hunterian Museum." This application was neglected, or perhaps refused. The result is known, how Dr. Hunter indignantly ordered that his museum, after remaining open during thirty years in London, should finally be removed to the University of Glasgow. Thus were the generous views of the noble donor contracted to a provincial town, which had extended for the metropolis, and through the metropolis to Europe itself; and the nation lost a proud possession. Sir Hans Sloane in his will expressed his wish that "his collections should remain together and not be separated, in or about the city of London, where they may, by *the confluence of people, be of most use*."

The improved knowledge of the present day has surely not come to us weakened by any diminution of public spirit;—and I believe that the patriotic feeling will be last to die away among these noble enthusiasts. The public wants, when properly understood, will often be supplied, as they have been, by this uncommemorated race. A personal feeling individualizes them with their own collections, so that to preserve them entire inspires them with a feeling of an after-existence; it consecrates their tastes; it hallows, with a sort of immortality, occupations which their death only had interrupted.

To afford these persons the security they desire, and to direct the full stream of their public affections into the right channel, remains still to be done; nor have we yet honoured these men, whose habits of life are secluded and unobtrusive, while their minds are often wayward and fanciful; too often their generous tempers have sown their seed on some rock, or on the heath, which ought to have expanded in the shelter of the garden. ANTHONY STORER, one of these most active but silent collectors, consumed his fortune in a collection chiefly of prints and drawings, which he bequeathed to the library at Eton; but from the nature of that and similar institutions, these donations might be inscribed with a "*hic jacet.*" There they can only repose in the gilt sepulchres of library-cases, rarely to be opened. All such things, to be useful must be of immediate attainment. A contemporary, who has nearly concluded an illustrated Clarendon, consisting of many folios of historical, antiquarian, and miscellaneous curiosities *, is most anxiously concerned where to deposit the unique collection; so imperfectly known to him, or so suspected, is the safeguard of such treasures, the British Museum, that I fear this collection will be of no service to the future historian.

I am convinced that many such noble spirits are still busied in the delightful task of creating such inestimable collections in literature, in science, and in art; and that to awaken and to foster their noble impulse, becomes an object of national interest. It is to be regretted that the stores of English literature of the late Mr. BINDLEY have been lost to the British Museum; for, strange to say, it is most deficient in those home productions which constituted the greater part of that collection. In these cases the deficient zeal either on the public's side, or on the collector's, might be corrected by a purchase after the life of the possessor, on the plan of Sir Hans Sloane, the Harleys, and Townley; where a commercial bargain was not struck, but a price, very far beneath the cost, was fixed, that the individual might not be entirely a sufferer, nor the public want the benefit of collections formed by such skilful men.

Recently two brothers, members of New College, testified their filial love to their Alma Mater, by presenting the university with a collection of the finest casts from Italy of works of art, so long wanting in that classical region; and those exotic plants, brought by the hands of two modest and unambitious Oxonians to their brothers, will assuredly scatter the seeds of taste in minds which have not, perhaps, been unjustly reproached, as being more curious of words than things.

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* It may be worth noticing, that these cost the collector, it is said, twelve thousand pounds.

Such are the men who, at long intervals of time, appear, and supply the wants of the Public from their own love and sensibility; and from these collectors, when opulent, the BRITISH MUSEUM must look forwards for many accessions. It has had its Cracherode, its Birch, its Musgrave, and many others, who have so largely and so preciously contributed to its stores. On this occasion let me borrow the simplicity and the force of the venerable style of Sir Thomas Bodley, alluding to his noble foundation of the Bodleian library: "For we cannot but presume that casting (counting) what number of noble benefactors have already concurred, in *a fervour of affection*, to that PUBLIC PLACE OF STUDY; *we shall be sure, in time to come, to find some others in some measure* OF THE LIKE DISPOSITION to the advancement of learning." With the prescient enthusiasm of genius, BODLEY foresaw those generous spirits, who, long after, and at intervals, have carried on his great views.

29th April.

ART. VI.—*A* TIGER AND LION HUNT.

[THE following narrative of a TIGER and LION HUNT, in the upper regions of Hindostan, is extracted from the familiar correspondence of the dauntless heroine of the chace, who is a British lady of high rank, recently, or not long ago, returned from India.]

Sanghee, sixty miles N. W. of Dihlee,
22nd March.

WE had elephants, guns, balls, and all other necessaries prepared, and about seven in the morning we set off. The soil was exactly like that we had gone over last night; our course lay N. W. The jungle was generally composed of *Corinda* bushes, which were stunty and thin, and looked like ragged thorn bushes; nothing could be more desolate in appearance; it seemed as if we had got to the farthest limit of cultivation, or the haunts of man. At times, the greener bunches of jungle, the usual abodes of the beasts of prey during the day-time, and the few huts scattered here and there, which could hardly be called villages, seemed like islands in the desert waste around us. We stopped near two or three of these green tufts, which generally surrounded a lodgment of water, or little ponds, in the midst of the sand.

The way in which these ferocious animals are traced out is very curious, and, if related in England, would scarcely be credited. A number of unarmed half-naked villagers, go prying from side to side of the bush, just as a boy in England would look after a stray sheep, or peep after a bird's nest. Where the jungle was too thick for them to see through, the elephants putting their trunks down into the bush, forced their way through, tearing up every thing by the roots before them. About four miles from our tents we were all surrounding a bush, which might be some fifty yards in circumference, (*all* includes William Fraser, alone upon his great elephant, Mr. Barton and myself upon another equally large, Mr. Wilder upon another, and eight other elephants; horsemen at a distance, and footmen peeping into the bushes). Our different elephants were each endeavouring to force his way through, when a great elephant, without a *houdah* on his back, called " Muckna," a fine and much esteemed kind of elephant, (a male without large teeth), put up, from near the centre of the bush, a royal tiger. In an instant Fraser called out, " Now Lady H——, be calm, be steady, and take a good aim, here he is."—I confess, at the moment of thus suddenly coming upon our ferocious victim, my heart beat very high, and, for a second, I wished myself far enough off; but curiosity and the eagerness of the chase put fear out of my head in a minute; the tiger made a charge at the Muckna, and then ran back into the jungle. Mr. Wilder then put his elephant in, and drove him out at the opposite side. He charged over the plain away from us, and Wilder fired two balls at him, but knew not whether they took effect. The bush, in which he was found, was one on the west bank of one of those little half dry ponds of which I have spoken. Mr. Barton and I conjecturing that, as there was no other thick cover near, he would probably soon return, took our stand in the centre of the open space; in a minute the tiger ran into the bushes on the east side; I saw him quite plain; we immediately put our elephant into the bushes, and poked about, till the horsemen, who were reconnoitring round the outside of the whole jungle, saw him slink under the bushes to the north side; hither we followed him, and from thence traced him by his growling, back to the outer part of the eastern bushes. Here he started out just before the trunk of our elephant, with a tremendous growl or grunt, and made a charge at another elephant farther out on the plain, retreating again immediately under cover. Fraser fired at him, but we supposed without effect; and he called to us for our elephant to pursue him into his cover.

With some difficulty, we made our way through to the inside of the southern bushes; and, as we were looking through the thicket, we perceived beau Tiger slinking away under them. Mr. Barton fired, and hit him a mortal blow, about the shoulder or back, for he instantly was checked, and my ball, which followed the same instant, threw him down. We two then discharged our whole artillery, which originally consisted of two double-barrelled guns, loaded with slugs, and a pair of pistols. Most of them took effect, as we could discover by his wincing, for he was not above ten yards from us at any time, and at one moment, when the elephant chose to take fright and turn his head round, away from the beast, running his haunches almost into the bush, not *fire*. By this time William Fraser had come round, and discharged a few balls at the tiger, which lay looking at us, grinning and growling, his ears thrown back, but unable to stir. A pistol, fired by me, shattered his lower jaw-bone: and immediately, as danger of approaching him was now over, one of the villagers, with a matchlock, went close to him, and applying the muzzle of his piece to the nape of his neck, shot him dead, and put him out of his pain. The people then dragged him out, and we dismounted to look at him, pierced through and through; yet one could not contemplate him without satisfaction, as we were told that he had long infested the high road, and carried off many passengers. One hears of the *roar* of a tiger and fancies it like that of a bull, but, in fact, it is more like the grunt of a hog, though twenty times louder, and certainly one of the most tremendous animal noises one can imagine.

Our tiger was thrown across an elephant, and we continued our course to the south-west; in a jungle, at the distance of about two miles, we started a wild hog, which ran as hard as it could away from us, pursued by a *Soowar*, without success. Soon after we started, in a more open part of the plain, a herd of the nilghau. This animal is, in appearance, something between a horse, a cow, and a deer; delicate in its legs and feet; like the latter, of a bluish grey colour, with a small hump on its shoulders, covered with a mane. Innumerable hares and partridges started up on every side of us. The flat dreary waste still continued, though here and there, at the distance of some miles, we met with a few ploughed lands, and boys tending herds of buffaloes.

In a circuit of about sixteen miles, we beat up many jungles, in the hope of rousing a lion, but without success. One of these jungles, in particular, was uncommonly pretty; it had water in the midst of it, in which was a large herd of buffaloes, cooling themselves. We returned home at 3 P. M.; and after a dish of tea I fell asleep, and did not wake till eleven at night.

On the 23d we again set off at 9 A. M. in quest of three lions, which we heard were in a jungle about six miles to the north-east of our tents. The ground we passed over was equally flat with that of yesterday, but it was ploughed. When we came to the edge of the jungle, not unlike the skirts of a coppice in England, and which was principally composed of stumpy peeple trees, and the willow-like shrub, I observed the other evening, Fraser desired us to halt, whilst he went on foot to obtain information. The people from the neighbourhood assembled round us in crowds, and in a few minutes all the trees in the jungle appeared to be crowned with men, placed there by Fraser for observation. After waiting nearly an hour, we were at last sent for. We found him posted just by the side of the great canal, which was cut by the Emperor Firoze, across the country, from the Jumna, at Firozeabad, to Dehlee, for the purpose of supplying the cultivation of this part of the country with water. Fraser had received intelligence of both a lion and a tiger being in this jungle, which now chokes up this canal. He desired Barton and myself to go down upon our elephant, and watch the bed of the canal; moving slowly towards the south, while he should enter and advance in the contrary direction; the rest of the party were to beat the jungle above, where it was so very thick, that in most places, it would have been impossible for an elephant to attempt to force a passage through it.

When we had gone about a quarter of a mile down the Nulla, there being but just room at the bottom for our elephant to walk clear of the bushes, we came to a spot where it was a little wider, and where some water had collected. Here we fell in with Fraser, on his elephant, who had met with no better success than ourselves, though we had all searched every bush as closely as we could with our eyes, in passing along. He desired us to wait there a few minutes, while he mounted the bank above to look after the rest of the elephants; though none of us were very sanguine of sport here, from the jungle being so thick, and so extensive on every side. He had hardly gone away, when the people in the trees called out, that they saw the wild beast in the bushes, on our left hand; and in a few minutes, a lioness crossed the narrow neck of the canal, just before us, and clambered up the opposite bank. I immediately fired, but missed her; the men pointed that she had run along the bank to the westward. We turned round, and had the mortification of seeing her again dart across the path, and run into the water, through the Nulla, for some yards; at which moment our elephant became refractory; kept wheeling about, and was so unsteady, as to make it impossible for us to fire. However, we followed her up to the thicket, in which she had taken shelter, and put the elephant's head right into it; when we had the satisfaction to hear her growling close to us. Just as we were expecting her charge every minute, and had prepared our musquets ready to point at her, round wheeled the elephant again, and became perfectly unmanageable.

During the scuffle between the elephant and the *Mahout*, we heard the cry, that the lioness was again running down the bank, and a gun went off. She again crossed the Nulla, and we saw the partridges start up from a thicket into which she had penetrated. Just as we got our elephant to go well in, she ran back again, and couched under a thicket, on our left hand bank, near to which she had originally been started. All this happened in the space of a short minute. Fraser then called to us to come round the bush, as the lioness being in a line between him and us, we hindered him from firing. Just as we got out of his reach, he fired; and as soon as our elephant stopped, I did the same; both shots took effect, for the poor lioness stirred not from the spot, but lay and growled, in rather a more mellow or hollow tone than that of a tiger. All our guns were loaded with slugs, and after a few discharges, poor lioness tried to sally from her covert, and rolled over and over into the bed of the canal below. Her loins were evidently all cut to pieces, and her hind parts trailed after her. This was lucky for us, as her fore parts appeared to be strong and unhurt. She reared herself upon her fore legs, and cast towards us a look that bespoke revenge, complaint, and dignity, which I thought to be quite affecting; perhaps, however, it was the old prejudice in favour of lions, that made me fancy this, as well as that there was an infinite degree of spirit and dignity in her attitude; her head, half averted from us, was turned back, as if ready to start at us, if the wounds in her loins had not disabled her. As it was now mercy to fire, and put an end to her sufferings, I took a steady aim, and shot her right through the head; she fell dead at once, and it was found, on going up to her, that the ball had completely carried away her lower jaw. Her body was dragged up the bank, and Fraser pronounced her to be not two years old.

We now learnt, that the shot which we had heard, when down below, was occasioned by the lioness having made a spring at a poor man, who stood panic-struck, unable to discharge his piece, or to run away. She had thrown him down, and got him completely under her, and his turban into her mouth. The elephants all dismayed had turned back, when Mr. Wilder, seeing the imminent danger of the moment, fired at the lioness, and grazed her side. She immediately left her hold, ran back into the jungle, and across the canal, where we first perceived her. This grand sight we lost, by being stationed in the bed below; it was said to have been very fine; but then we had, instead of it, several views of this noble animal, in full vigour; and with the sight of an hyena, which also ran across the Nulla.

We then proceeded on the road to Pannuput, on our elephants, five miles to ——— which is a pretty village. Here I got into my palankeen; Wilder returned to Dehlee; and William Fraser and Mr. Barton mounted their horses, and rode on as hard as they could. I changed bearers at Seerhana, twelve miles, and arrived at Pannuput, eleven further, at midnight. The gentlemen had arrived there about sun-set. After a little bit of dinner, I was glad to go to bed. Next day, the gentlemen told me, they had crossed again Firoze's canal, which appeared very *tigerish;* but that part of it, near Pannuput, was the finest corn-country they ever saw, and doubly delightful after the fatiguing and dreary wastes we had been in for the last six days. Pannuput plains were, in 1761, (1174 of the Hegira), the scene of one of the greatest battles ever fought, between the united musselman powers of India and the Mahrattas, in which the latter were defeated; fifty thousand Mahrattas are said to have been killed, and the battle lasted three days. No traces of the field of battle are left, the whole plain being in the highest state of cultivation. It is a beautiful scene, scattered with fine trees, and the fort (a common brick one), and town highly picturesque.

William Fraser drove me to Brusut in his buggy, on the morning of the 24th; and from the plains of Pannuput I first beheld, with an old Highland play-fellow, the snowy mountains of Thibet, instead of the much-loved summit of Ben Nevis.

Art. VII. *Account of Batavia—Its Inhabitants, Commerce, Climate, &c. By the late* Dr. Gillan, *Physician to the Embassy to China, under* Lord Macartney.

(Concluded from Page 20.)

In Java and the neighbouring islands it is said that they produce extraordinary effects by means of a powder of singular composition, and of which they make frequent use. Mr. Titsing was an eye-witness to some of these effects while he resided in Japan, where he was for some time employed in the Company's business. This powder, he says, not only relaxes and unstrings every fibre of the living frame, but also preserves the dead from all rigidity and stiffness, while at the same time, from its peculiarly antiseptic virtues, it wards off putrefaction for a long time. When one dies in Japan, a skilful person comes, and taking a small quantity of this powder, puts it into the eyes and ears of the dead body. In a few minutes the joints regain their flexibility, the whole body becomes soft and yielding, every muscle contracts with ease, and they dispose of the dead in any attitude they please. Sometimes they place them sitting erect in a chair; sometimes as if reading or writing at a table; sometimes in a stooping, and sometimes in a horizontal posture, according as fancy or the choice of friends and relations dictate. This flexibility of the dead fibre, he says, continues as long as its organization remains entire, and that is for a long time. He was desirous to have a further proof of the efficacy of this singular powder, and an opportunity occurred to satisfy himself completely on this head. One of their own sailors died aboard his ship: two days after his death, when his body was now quite rigid and signs of incipient putrefaction appeared, he sent for one of those who perform these operations on the dead, to come and exhibit his art on the body of the sailor. He came accordingly, and demanded that the body should be immediately carried ashore. This was done, and the powder, as usual, put into the eyes and ears; in a few minutes the body became soft and flexible, in every part the putrefactive process was stopped, and Mr. Titsing saw the body in a cave many days afterwards, laid in a recumbent posture, quite pliant, and without further marks of corruption. He immediately purchased, at a considerable price, a small quantity of this extraordinary powder, but never made any use of it himself; he was even afraid to touch it, dreading that if it had such wonderful powers over the dead fibre, it might *a fortiori* have still greater effect upon the living one, and induce such a degree of relaxation as might never be recovered; and thus, perhaps, an event might follow as bad as, and more permanent than, from the Javanese fascination. He says he consulted the physicians of Japan for an explanation of these astonishing phenomena. They would not communicate to him the secret of the nature and preparation of the powder, which is reserved solely for the initiated; but told him the powder was absorbed from the eyes and ears when it first exerted its resolving effects by a particular system of absorbing vessels, which continued a certain kind of circulation for several days after death, and that these vessels carried it forward through the whole body, through every fibre of which, it communicated and diffused itself. This appeared to him a very satisfactory account of the matter, and he said he had lately sent one half of his powder, accompanied with this account, to Holland, in order that the professors of anatomy, in their different theatres, might make experiments with it. Such were the accounts Mr. Titsing gave, and he firmly believed the truth of them. He promised me a small quantity of this powder, with several other curiosities, but our sudden departure from Batavia prevented me from seeing him afterwards, or receiving them.

The very short time we stopped at Batavia, rendered it difficult to make many observations on the natural history of the place. But we laboured also under a double disadvantage in this respect, in not being able to find any person there conversant with this subject. The Dutch gentlemen, who are at the head of the Company's affairs, are more occupied with commerce and the acquisition of money, than the pursuits of science; and many of them who have risen to offices and fortunes, were originally in very inferior, and even mechanical situations in life, and never had the benefit of much education. Hence they have contributed little to the advancement of natural history, although the country abounds with materials. At some future period it may be more cultivated. There is even an Academy of Sciences lately established at Batavia, but there appears no great spirit of science among its members, nor does it promise much for their zeal that they have allowed all the astronomical and mathematical instruments of the Rev. Mr. Moln, to be sold piece-meal after his death; and the observatory to be converted into a warehouse for the Company's goods. They have already, however, published six volumes of their transactions; but as far as I understand, there are hardly any of the memoirs written by the Batavian resident members.

It has been already remarked that the situation and climate of Batavia are peculiarly unhealthy. The dirty waters carried down by the rivers from the Blaeu-wen-berg Mountain, stagnate in the canals with which the whole town is intersected, and deposit a prodigious quantity of slime and filth, which is not cleared away as it ought to be. The great canal which unites all the smaller ones into one stream before it enters into the sea, is gradually becoming shallower from this constant deposition of dirt and mud; and I was assured it had extended the point of land where it discharges itself into the bay, to a considerable distance farther than it was when Batavia was built. The bay all around the mouth of the canal to the distance of two miles, is a dirty muddy colour, and quite distinct from the colour of the sea-water farther out. The bottom, formed from this mud and clay, makes excellent anchoring ground. The quantity of putrescent animal and vegetable substances that float down the canal into the bay, and there remain in a putrefying state, and agitated by the waves, gives a beautiful phosphoric appearance to the surface of the water at night, especially when ruffled by the sea breeze. The town is large, but seems thinly inhabited, and many houses are quite empty. The houses are built, some of brick, some of stone and lime, and some only of wood and plaster. It is remarkable, however, that neither limestone or marble of any kind have yet been found in Java. They get the whole of their lime from the coral rocks, which abound in, and in some places almost entirely compose the neighbouring islands in the Straits. They send for boat-loads of it, and burn it in the usual manner. The bastions of the two small batteries or forts which guard the entrance of the great canal leading from the bay to the town, are entirely built of this coral rock, and it appears extremely well calculated for this purpose, as its splinters would by no means be so numerous or so dangerous as the lava stone, of which the walls of the town are partly built. The only stone I saw here was of a dark blue colour. It is of a very hard dense texture, emits a metallic sound when struck, and resembles very much the lava of Vesuvius. This stone they get chiefly from the mountains, which I was told are all volcanic. In one place, about forty miles from Batavia, there is a crater still smoking. They get their marble and granite from China. The Chinese junks carry it to Batavia, but seldom as a loading; most frequently they bring it as ballast. The ground-floors of the principal apartments of the Governor and Council of the Indies in the castle, are paved with this marble, which is cut into squares of eighteen inches, for this purpose. One of these squares, when polished and laid, costs about three shillings sterling. For the pavement of their apartments they choose marbles of various colours, especially black, blue, and white, which they intermix and lay in figures of a diamond, as in Europe. Sometimes they line the faces of the sides of their rooms with this marble, to the height of about three or four feet. And often too they use for this purpose a composition of lime and pounded shells, which the Chinese call chinam. This they lay on in the form of plaster, and paint it with various colours representing the veins of marble, and afterwards polish it so well, that unless it be very closely examined, it might readily be mistaken for real marble. The houses in general rise a few steps from the street. The steps of the stairs leading up to them are sometimes of white rough marble, but most frequently of granite. The houses of lower people, and even several of the rooms in those of the higher and richer classes, are paved with large flat tiles, which they import from Holland. As there is a canal in the midst of every street, and the banks on both sides are thickly planted with trees, their shady leaves gave a pleasing appearance to the eye, and contributed to make the streets and the houses cooler;

but as their noxious effects in other respects were certainly more than a balance for this, an order was sent from Holland for cutting them all down. This order has been put in execution in some streets, and it is said it is to be enforced in all. It would certainly be much more pleasing to the eye to leave a few trees here and there at different distances, and all the good effects would be equally well obtained.

The country round Batavia, and thence back to the mountains, which are about forty miles distant, appears like one continued plain, without any hill or rising ground to interrupt the view. It is so thickly planted with trees at the same time, both in the fields, along the canals and banks of the rivers, and around the gardens and country-houses of the inhabitants, that it has rather the appearance of a forest, than of a cultivated country. I had an opportunity of going into the country behind Batavia twice; first to Mr. Wiegerman's country-house, and afterwards to Mr. Schowman's. The road leading from the town appeared nothing for several miles but a mound of earth thrown up between two canals, and formed of the soil dug up to make their bed. From the gate of the town till we came to the Pasar Tannabank it appeared one continuous level plain. Pasar Tannabank rises suddenly about thirty feet perpendicular above the level of the road; and after you come to the top of this small eminence, the road continues level, and almost parallel to the horizon as before. Mr. Wiegerman's country-house is about two miles beyond Pasar Tannabank, and seven from Batavia. There is nothing particular to be seen either in the house or adjoining grounds. The general character of the country prevails; thick shady trees, planted in regular rows, forming avenues that terminate in a central point, as it were before the house built on that centre; and diverging and forming radii of a circle all around, seem to have been disposed and arranged with peculiar care. The grounds around are wet and marshy, and nothing here appears inviting except the hospitality and *bons vivres* of the master. He seldom comes here, and only for a night or two. The house is fitted up rather for the reception than for the convenience of numerous guests; at least, according to the European idea. There is one large hall for dinner; a portico for shade, drinking, smoking, and conversation and cards; and several detached bed-chambers. But in each of these there are at least three beds, and not one pair of sheets in the whole of them. In this circumstance they seem to forget that strangers newly arrived from Europe are not accustomed to, nor provided with, the flowing easy night-dress of eastern climates; and that they may possibly pass a disagreeable night from damp and noisome vapours, as well as from the warm apprehensions of imagination that often presents to them the disagreeable images of the fevers, and complicated diseases of those who may have contaminated the mattress and counterpane on which they now, in vain, seek repose.

These roads which lead from Batavia back to the Blaeu-wenberg mountains, and no farther, and which have all been made by the Dutch, are divided in the middle by a paling of bamboos. One side the road is smooth, and appears to be particularly attended to; it is destined for carriages, horses, and travellers. The other side appears one continued puddle. It is the road for the buffaloes, which they employ here for ploughing the rice grounds, and dragging the carts and waggons. The wheels of these carts are made of one entire piece of wood, the cut of the trunk of a tree, about four feet diameter, and extremely thin; so that the breadth of the circumference, rolling on the ground, does not exceed a couple of inches. From this uncommon thinness they are very brittle, and cut the road like a knife, so that the wheel sinks to the axle-tree at every step. These carts are commonly heavily laden, and no care is ever bestowed upon filling up the ruts the wheels have cut; the buffaloes sink to the belly at every step, and their march is so retarded that they scarcely advance half a mile an hour. The body of the cart or waggon is made like a chest, and must be water-tight, otherwise every thing contained in them would be spoiled. The buffaloes are very common here, but none of them are found wild in the mountains or woods. They are not so large as the buffaloes of the southern parts of Europe, nor do they appear to be so strong. They are generally of a dirty dun colour; the hair is very thin, and particularly on the belly, which is almost bare. Their nostrils appear more patulous, and their ears larger. They have no palearia. Their horns are all curved backwards in a horizontal direction round the head, so that the tips of them almost meet each other over the neck. This singular position of the horns almost renders them useless as weapons of defence; and they seem rather to butt with them like a ram, than to toss like a bull. They are quite gentle and tame in the hands of the natives. The Malays and Javanese have brought them into perfect subjection. Even the children ride upon their backs when they drive them to feed in the marshes, or to draw the cart and plough; and sometimes half a dozen of them mount upon their back, head, and neck, by way of amusement; the animal all the while remaining perfectly quiet and gentle. But these same animals become wild and ferocious at the sight of a European, whose dress and appearance seem to offend them exceedingly. The Malays, from whose bodies we perceive a disagreeable effluvium perpetually issuing, pretend that the Europeans offend their nostrils in the same manner, and that it is this disagreeable emanation that stimulates the olfactory nerves of the buffaloes, and excites in them such a disagreeable sensation that they are provoked to the utmost anger against the exciting cause. It is certain that it is not safe for a European to approach them while they are at liberty, although they are soon tamed, and patient enough under his hands and treatment in the stall. Of this we had several examples in the lion, where the wildest and most ungovernable always became very tame and tractable, when tied to the guns for a few days.

The Javanese drive these buffaloes every morning and evening into some of the canals, or into a deep ditch, where the water covers their whole bodies, except the head, which they hold up in order to breathe. In this situation they remain for a long time, while the master or driver, with a long scoop in his hand, throws water over their heads incessantly. They seem much pleased with this bathing, and always turn to meet the water, nor once offer to stir from the place till they are commanded.

The Dutch have a particular and inveterate prejudice against eating the flesh or drinking the milk of the buffalo, both which they pretend to be productive of disease. But the Malays and Javanese eat them both without any ill consequence. The

Chinese do the same; and while we remained in the Straits of Sunda, the crews of all the ships ate the buffalo, and found their flesh very good. It made excellent soup, and the flesh when stewed or boiled till it was quite tender, appeared not at all disagreeable to many of the gentlemen. Captain Macintosh had it made into Scotch collops aboard the Hindostan; and in this state, when properly dressed and seasoned with the usual condiments, it was impossible to distinguish it from European beef dressed in the same manner. These animals appear formed by nature for ploughing the rice grounds, which are so wet and marshy, that neither horses nor oxen could work in them. Each plough is drawn by a single buffalo, the plough is light, but the coulter and plough-share strong and broad. The ploughman follows after, naked from the waist downwards, and the furrow appears to consist as much of water as of soil. They have two kinds of rice—first, the common kind, which grows only in low wet grounds, and requires water constantly for its growth and ripening. Secondly, the mountain, or dry rice, which the Javanese call paddy gunning. It is commonly sown on the sides of the mountains about the beginning of the rainy season; it requires no water other than the rain and dews, and ripens about the beginning of the dry season.

There is a warehouse for drugs at Batavia, in which are deposited all the drugs of India, till they are sent by the Company's ships to Holland. There is also a Hortus Medicus for making a collection of the plants of the country, about a mile from the town, both belonging to the Company, and under the management and direction of Mr. Schowman. The island, in all probability, would afford a great number of very rare and valuable plants; but it has hitherto not been explored, nor have any persons of botanical knowledge been employed for this purpose. Accordingly the Hortus Medicus does not contain a very large collection, nor is the present superintendent of the garden well calculated for increasing it. Mr. Schowman came to Batavia when young, and in a very low capacity; he is ignorant of letters, and unacquainted with every part of science, except the names and knowledge of the few plants and trees he has in the garden, with the habit and appearance of which he has got mechanically acquainted. He was persuaded to marry a Malay slave, who had long been the favourite sultana of the late Governor-General; and in consideration of this sacrifice, he was appointed to the double office he now holds, in which he has acquired a good deal of land and property in the country, and a very considerable fortune in money. We visited the Hortus Medicus in company with Mr. Wiegerman, and some other gentlemen, and we thought this an excellent opportunity of ascertaining the history of the famous upas tree. The gentlemen of the council at Batavia denied the existence of the upas, and Mr. Schowman confirmed their negation. It seems the Governor and Council had been applied to from Amsterdam, to ascertain the truth or falsehood of this history. In consequence of this application they made inquiries, the result of which they thought warranted them to conclude no such tree existed. I procured a copy of the official paper, transmitted to Holland, containing the detail of their investigations, from M. Engelhart. This paper I gave to Sir George Staunton; and to it, it is best to refer for any thing further on this head. But we were not a little surprised, some time after we came out of the garden, to understand from Mr. Schowman, that he actually knew, and had in the garden where we had been, a tree, which he called, and believed to be, the upas, although it had not all the extraordinary qualities ascribed to it by Mr. Foersch. He said this tree was of an extraordinary poisonous nature; that it exuded a resin or juice, with which, when a sword, cress, or other cutting weapon, was impregnated, or even touched over, the weapon inflicted a certainly mortal wound. That the reason why he denied the existence of such a tree was, because the slaves and servants were around us while he spoke, and that he did not choose they should ever believe such a poisonous tree existed, much less that it was then growing in his garden, lest at any time they should be tempted to make an improper use of it. That the same reason had made him conceal it from every person at Batavia, except the Governor-General, and a few of the members of the Council, dreading that if it was once generally known, the worst consequences might result from it. He promised to shew us this upas privately, when we returned from his country-house, to which he had invited us, and where Sir George, Mr. Staunton, and I were to accompany him next evening. But of this sight we were disappointed too, as we left Batavia the day before Mr. Schowman was to return to town. He showed us, however, several plants of the nutmeg tree, that had been lately brought to Batavia from the Isle of Banda, its native soil.

These plants were in a very thriving condition, and we had the satisfaction of obtaining some specimens of it, among the other productions of the garden, which were sent home by the Sullivan. One of the nutmeg plants was grown to the size of a small tree, and was planted in the earth; the others were smaller, and in pots of Banda earth, which had been sent along with them, from a belief formerly entertained that the nutmeg would not grow in any other soil. I examined this earth, and found it to be volcanic ashes, with a very considerable proportion of iron in them. Mr. Schowman had also received some of the nuts along with the plants. The nuts were sent to him in close jars, with a liquor round them, which he afterwards told me was pure water; he had planted some of these nuts in small pots of the common earth of his garden, and found to his great satisfaction that they seemed to grow very well in the soil of Batavia; and he entertained hopes that ere long they might be sufficiently multiplied in the Dutch territory in Java. The nutmeg has, in its native state, a very hard shell around it, which is broken in order to take out what we usually call the nutmeg in Europe, but which is in fact only the nucleus or kernel of the nut. Between the nut and the kernel there is a thin membranous substance, which lines the shell and covers the kernel, to which it adheres when the shell is broken—this is the mace. I went with Mr. Schowman the following evening to his country-house: Sir George, Mr. Staunton, and Mr. Wiegerman, were to follow after, an hour or two later, or at any rate the succeeding morning, unless something should occur to prevent them. The house is situated about six leagues from Batavia; the road leading to it passes by Mr. Wiegerman's house already mentioned, and is very good for four or five miles further: after that, the country becomes quite marshy, and there are several lakes and rice fields interspersed, which being covered with water appear only a continuance of the larger lakes. On the banks of one of these lakes, and in a pleasant situation, there is a very fine villa and garden, which, with a large tract of the adjoining country, belonged to the late Admiral Hartsink, and is now occupied by his son, who was then residing there with his family. We had relays of horses at different distances; for although the horses of Java are very spirited, and go exceedingly well, they are small, and are soon fatigued from the heat of the climate, and the depth and heaviness of the roads. We had four relays for the six leagues we drove; slaves had been sent on with them before, and they took their stations at different distances, and remained with the horses under the shade of the trees, or feeding them by the side of the hedges, till we came up.

It was our intention to have proceeded the following day to the foot of the mountains, to see Mr. Schowman's larger collection of plants, which he said he had there, and particularly the tree which produces the elastic gum; he told me they had considerable quantities of it in their warehouses at Batavia, the produce of these trees, but that it was always adulterated before it was sent to Europe; and from this circumstance may arise some of the seeming contradictions in the experiments of different chemists in Europe, and who possibly may have operated on different sorts of it.

We anxiously waited for Sir George's arrival, but as circumstances had occurred to prevent him from coming at all, I did not think it proper to proceed alone, nor to wait any longer there, and therefore returned to Batavia next afternoon.

Mr. Schowman has a large farm here, and a considerable estate, which he has let to a number of tenants, Jayanese, Malays, and freed slaves, in small detached portions; these tenants came to pay their respects and their monthly rents, to their landlord, while I was there. These poor wretches are not permitted longer credit for payment of their rents, than from month to month: when they approached the hall where Mr. Schowman sat, they fell on their knees, and when they spoke to him they did it always in the same humble posture. I observed their payments were all made in Company's paper, which they delivered also on their knees to Schowman, who received it from them with great dignity; nor did they quit that posture till he had done speaking with them.

I took a walk out alone, to see the houses, families, and occupations of these Indians. Mr. Schowman, and the gentleman who had accompanied me from Batavia, would not venture out in the heat ofthe day, but sat in the hall, drinking Madeira and small beer, and smoking their pipes. Their houses appeared tolerably clean and comfortable; the women were employed in various domestic occupations—some of them were beating rice in wooden troughs, others cleaning it, and others in pounding the cleaned rice into a fine flour; and I observed a few of them employed in weaving striped cotton cloth, and others painting handkerchiefs and shawls of white cotton cloth, with a kind of paint made of cocoa-nut oil, gambir, and a brown earth from the mountains. The instrument they used for painting was made of wood, and resembled a pair of candle-snuffers, the chamber of which contained the paint, which the point, drawn very fine and tubulated, permitted to flow through it in small lines. As the paint was disposed to become thick and viscid, and on this account, as well as to fix it better in the cloth, required to be very hot, it was placed in an earthen jar over a few coals, and in this manner always kept fluid beside them; we had observed one of Wiegerman's paysannes employed exactly in the same way at his country house. The men and the children were all in the fields, or in the garden, occupied in cultivating the ground. Mr. Schowman had a number of them employed in his grounds, where he was preparing a new plantation of coffee, and sowing the phaseolus from whence the oil is made, which they burn universally here in lamps instead of candles; the oil is expressed in a mill made for the purpose, and the refuse, resembling our oil-cakes in Europe, is employed in the same way in feeding cattle and manuring the ground. For lighting the bed rooms, they usually take a common glass tumbler of a pretty large size, they fill it half full of water, then pour this oil on the top of it, place a floating wick on it, and having lighted it, they place it in a basin of water in a corner, and leave it burning there the whole evening, and often the whole night.

In a garden adjoining to the house, Mr. Schowman shewed me the cinnamon tree; the cassia lignea, and another large tall tree, whose bark resembled much, in its taste and other qualities, that of the cinchona. He told me that the Javanese made use of a decoction of it for curing their fevers, and that it had been but very lately pointed out to him as deserving notice. He had not yet ascertained its class, order, or genus, in the Linnæan system; but he said, the trials hitherto made of its medical virtues were very favourable. There were considerable quantities of the Piper longum and rotundum, the Convolvulus Jalappa, Styrax liquida, Betel, and Areca. I got specimens of every thing from him, all of which have been sent home; he readily promised me specimens of all the drugs in the warehouse, when he should return to town, but we had sailed before he came.

Madame Schowman seemed as willing to give information as her husband; she was now much advanced in years, but seemed still to remember she had once been the favourite of the Governor-General of Batavia, the mightiest potentate in her estimation in the whole earth, of which her idea seemed to comprehend little but the great island of Java. She had a prodigious number of jewels, and precious stones of various kinds, but she appeared to value two more than all the rest; I examined them very particularly, and could discern nothing to entitle them to uncommon preference. I had heard much at Batavia of certain kinds of gems, which they told me were produced and found in certain flowers, and which were accounted of very great value; and I was told that many of the ladies wore them in their head-dress at the ball the Governor-General gave out of compliment to his excellency the Ambassador. Madame Schowman informed me these were the gems; that the first was the produce of the flower of the mountain rice, said to be generated there by the falling rain, and on that account called by a Malay name, signifying Son of the Showers. It was of a small size, oval-shaped, of a milky opaque colour, and set in gold. There is not the least truth in the story of its origin, although Schowman himself affirmed it authentic, and every body I spoke to at Batavia had received the account of it as genuine. It was nothing but an agate: she permitted me to try it with steel, which she said it would cut, and thought that circumstance a proof of its high value. It readily gave fire with the back of my pen-knife, and had every character of agate, so as to leave no doubt about its nature. The other kind was still more precious; it was found in the flower of the Polyanthus Tuberosa—this was of rare occurrence and generated in the bottom of the flower by the dew that fell on the flower and lodged there during the night; hence it was called by a Malay name, signifying Daughter of the Dew; it was of a smaller size, but nearly of the same shape and colour as the former; she would not permit the same trial of this as of the former, as she said it was of softer texture, and might be easily broken. This ridiculous account was equally current and credited as the former. She told me another story of the polyanthus tuberosa, which appeared more natural and probable, which I was assured by every body was certainly true. This flower, like all others at Batavia, emits hardly any smell during the day, which is generally the case in hot climates; but in the cool of the evening it exhales a very pleasing odour, and on that account is usually chosen by the ladies for adorning their hair, and strewing in their beds and bed-chambers; on this account, they call it in Malay language, Sultana of the Night. But it is also destined for another purpose; they string the flowers like pearls on a silk thread, and make garlands and chaplets of them, by means of the form and position of which, they hold silent converse with their gallants at the ball or assembly. When placed on the right or left side of the head, high or low, farther forward or backward, larger or smaller in size, they convey different messages and meanings; but this language is conventional, and always previously settled between the mistress and the gallant. They often change their conventional alphabet to prevent discovery, and they always change it *in toto* when they form new connexions. She seemed to talk of these things with the reminiscence of former times, and with the skill and knowledge of one who had often practised them. When a Javanese belle has any secret declaration to make to a gallant on whom she may have cast her eye, she usually contrives to send him privately a chaplet of these flowers, and the fruit of the Durion, which is exceedingly large, resembling in shape a water-melon, with a very thick rough rind, and divided internally into numerous lobes, containing each a kernel resembling those of the Jack, and tasting like a mixture of boiled garlic and onions.

The phaseolus, from whence the oil is produced, grows wild in Java, and in great abundance. It appeared a most valuable plant, and I wished much to get some ripe seeds of it, in order to send them to England. Mr. Schowman told me they had been sent to Holland some years ago, and that they succeeded very well, even in the open air.

I had always been told that light attracted musquitoes and flies at night, and I had always seen the servants enter into the rooms, and shut the windows, in Italy and the southern parts of France, before they carried a candle into the bed-rooms. It seemed to me that the practice, therefore, of burning oil in the evening, and through the night, in the bed-chambers, would have the same effect here, and that it was, therefore, a bad custom. Mr. Schowman told me, that it was remarked that this oil emitted a smoke, or smell, that banished the musquitoes, and that, on that account, it had come into such general use. In the country, and in the suburbs of Batavia, they are accustomed to burn resins, aromatic woods, tobacco, and the dry leaves and twigs that fall from the trees, in order to drive away these troublesome insects; as well as to disperse the thick vapour and noxious effluvia of the stagnating waters around them. Mr. Schowman seemed to make greater difficulty in giving me specimens of the pepper than of all the other plants, and he always contrived to prevent me from pulling them myself. I remarked that he always avoided those whose grains appeared most approaching to maturity, and chose those which were quite green. I was at a loss for some time to account for this, till the gentleman who returned with me to Batavia in the evening explained it to me. It seems the Dutch are particularly jealous of their pepper, and take every precaution to prevent any ripe seeds of it from being carried away in a state capable of vegetation. It is death for any one caught in their spice islands attempting to carry off any of the plants or seeds, with a view to disseminate them elsewhere. We were told, however, by the French captain, from whom the Nereide, (afterwards named the Clarence was bought) that about fourteen years ago, a French ship went to Ceylon, and found means to carry off several plants and seeds of many of the spices, which were carried safe to the Isle of France, where, he said, he had frequently seen them himself, and particularly the pepper, in a thriving condition. He says, however, that the pepper does not form itself into such large grains as at Ceylon and the other Dutch settlements, but in other respects it is exceedingly good. This circumstance may, perhaps, one day hurt the Dutch very materially.

ART. VIII. *An Analysis of Wootz, or Indian Steel. By* M. Faraday, *Chemical Assistant to the Royal Institution.*

THE object of the following experiments being to ascertain whether any other substances were present in the wootz than iron and carbon, no attention was given to the relative proportions of these two bodies. The process was therefore much simpler than would otherwise have been required, and was conducted in the following manner :—

A piece of wootz, weighing 164.3 grains, was placed in a flask, and acted on by nitro-muriatic acid and heat. It gradually dissolved, and dark-coloured flakes separated from it, which were unalterable in the acid, though boiled with it. When all action had ceased, the solution was poured off from the sediment (*a*) which was repeatedly washed with distilled water; the solution was then examined carefully, but I could find nothing in it but iron. Whilst washing the sediment (*a*) it separated into two parts; a black powder (*b*) sank to the bottom of the water poured upon it, whilst a reddish brown substance (*c*) in flocculi remained suspended; these were parted from each other.

The black powder (*b*) was fused with potash in a silver capsule, and then dissolved in water; it deposited a brown powder (*d*), and a clear alkaline solution was obtained. This was saturated with muriatic acid, and evaporated to dryness, and then being re-dissolved with a little excess of muriatic acid, a very small quantity of white flocculi were left untouched, which were insoluble in acids, and had the characters of *silex*. The solution acted on by subcarbonate of potash gave an abundant precipitate. This was washed, and when heated with a little solution of potash, dissolved in it like *alumine*. Sulphuric acid was then added, and a solution of alum was obtained, a small quantity of silex precipitating.

The brown powder (*d*) deposited by the alkaline solution, was treated with nitric acid; a little heat being applied, nearly the whole was dissolved immediately, leaving a little of a black substance. The filtered solution gave a precipitate with muriate of soda, but when ammonia was added to it, the precipitate was re-dissolved, and a small quantity of iron was thrown down. The solution contained, therefore, *silver*, from the capsule in which the fusion had been made, and *iron* derived from the wootz. The black substance left by the nitric acid, was nearly all dissolved by nitro-muriatic acid, iron being taken into solution, and a little of the substance (*b*) remaining.

The reddish brown substance (*c*) was not affected by nitric acid, but, on adding solution of pure potash to it, a clear deep brown solution was obtained, and a blackish brown sediment (*e*) remained. When the alkali of the solution was neutralized by muriatic acid, flocculi were precipitated, and the solution became colourless. These flocculi, collected together and dried, proved to be combustible, and appeared to be merely modified tannin. The brown sediment (*e*) being then examined by muriatic acid, gave oxide of iron and a little *silex*.

I have detailed the process of analysis at length, because from the small quantities of silex and alumine obtained, doubts otherwise might have arisen respecting their sources.

The wootz, operated upon in the above experiment, was part of one of the cakes presented by the Right Hon. Sir Joseph Banks to Mr. Stodart. The piece was cut from the middle of the cake when heated to a cherry-red colour; consequently, it was submitted to chemical analysis in the same state in which it came from the crucible of the Indian-steel maker. In some other experiments 460 grains gave .3 of a grain of silex, and .6 of a grain of alumine.

Mr. Stodart at the same time furnished me with another specimen of Indian steel, expressing a wish that it also might be subjected to analysis. This, too, was in the same state in which it was imported. The appearance of it, whilst being acted on by the acid, was very different to that of the wootz, and 625 grains gave me *no silex*, and only fifteen hundredths of a grain of alumine.

420 grains of the best English steel, furnished by Mr. Stodart, were acted on, but I could obtain no earths from it. A slight appearance of opacity in a solution was at last produced, which I ascertained to be alumine contained in the tests I had used. Many comparative experiments were afterwards made with the three specimens of steel, those from India always appeared perfectly distinct from each other in the kind and quantity of earths they gave, and the English steel invariably appeared without the earths; neither was the slightest reason offered for the supposition I at first entertained, that the earths came from the tests used in the analysis.

Being engaged in the laboratory of the Royal Institution with Mr. Stodart, in a series of experiments on the alloys of steel, I was desirous, among other researches, to make an experiment, with a view of imitating wootz. In this, however, I have not yet been very successful; I have obtained specimens of iron, giving abundance of silex and alumine on analysis, and such alloys or combinations have been obtained by others; but they never present the appearance of wootz during the action of acids upon them, even though the metal used in making the alloy be in the state of steel; and if wootz owes its excellence to any portion of the bases of the earths, silex or alumine, combined with it, those substances must, I think, be either in a more perfect, or in a different state of combination, to what they are in alloys obtained by fusing iron for three or four hours, in contact with wood and the earths.

April 24th 1819.

Art. IX. *On Sirium, or Vestium, by* M. Faraday, *Chemical Assistant in the Royal Institution.*

In the last volume of this Journal, at page 112, I have published some experiments, tending to disprove the existence of the new metal Sirium, said to be discovered by Dr. Vest; and the conclusion drawn from them was supported by the very high authority of Dr. Wollaston. Since that time I have been honoured by receiving a piece of the ore of Sirium from Sir Humphry Davy, and on reading in the *Annals of Philosophy* a translation of Dr. Von Vest's paper, in which the metal, and the method of procuring it, are more distinctly described than had been done before in this country, I considered it a sort of justice to that chemist, to endeavour to obtain from the ore I possessed the new metal, according to his processes.

The metal has received a new name from Dr. Vest, who, instead of Sirium, has in his paper called it Vestium; Sirium and Vestium are therefore synonymous, and I shall generally use the latter.

The piece of ore I possessed weighed only 75.4 grains. It appeared perfectly clean, and being finely powdered, was digested in nitric acid. It was not previously fused with glass as directed, because it did not appear to contain any calcareous spar, and also because of its small quantity. The nitric solution was poured off after two days, a greyish white powder was left, which, when dissolved in nitro-muriatic acid, gave nickel, cobalt, iron, and arsenic.

Dr. Vest directs the neutral nitric solution to be mixed with acetate of lead. In order to render my solution more nearly neutral, subcarbonate of potash was added in quantity not quite sufficient to saturate the excess of acid, and the carbonic acid driven off by heat. In this way a greyish green powder was separated, which contained nickel in abundance, with cobalt and arsenic, and a slightly acid solution remained. To this, acetate of lead was added in excess, and the mixture left in a warm place for twenty-four hours as directed; the arseniate of lead was then separated, and sulphuric acid added to separate the excess of lead, and then by filtration a clear solution was obtained.

The next object, was, to separate the nickel from the solution, and this Dr. Vest directs to be done, by forming it into a triple salt with sulphate of potash. The solution obtained as above was concentrated, that a portion of a salt of Vestium in fine white needles might fall down, but this did not happen. It was then diluted, decomposed by potash, the precipitate washed, and dissolved in sulphuric acid, and the excess of acid saturated by potash; then more sulphate of potash was added, and the whole was evaporated, and left to crystallize. After some time the crystals that had formed were separated from the solution, and washed with cold water, and the washings being added to the mother liquor, with more sulphate of potash, it was again evaporated and crystallized. This was repeated three or four times, until sulphate of potash separated no more nickel from the solution; and now, according to Dr. Vest, I ought to have had in the solution sulphate of vestium, moderately free from other metals.

I looked eagerly for the white flocks, which are described as forming a salt of Vestium on the crusts of triple sulphate of potash and nickel, in the above process of purification, but could not observe any. I dissolved all the crusts, and re-crystallized them two or three times over, that any salt of vestium contained in them might be separated, but did not procure the flocculi as I expected; I obtained, however, a residuary solution (being the mother liquor) similar to the one mentioned above.

These solutions, being added together, were precipitated by carbonate of potash, and boiled in excess of it; the precipitate was washed, heated red hot, digested in cold diluted muriatic acid, and the green solution which was produced poured off from the portion which remained undissolved; the solution contained nickel and cobalt. The undissolved part was boiled with muriatic acid and dissolved, forming a solution which ought to have been the muriate of vestium.

The solution I had thus obtained by Dr. Vest's process, was in very small quantity, but I hoped to be able to ascertain Vestium in it. It had a faint yellowish green colour. It was evaporated to dryness, and re-dissolved several times, but no white flocks separated, as was expected from Dr. Vest's description. It agreed with the account of Vestium, in being precipitated by prussiate of potash, white, and by sulphuretted hydrogen, dark, brown, and black. It was precipitated by ammonia, and dissolved in excess of ammonia. It was precipitated by carbonate of ammonia, and dissolved in excess of the carbonate, nor was it thrown down by oxalate of ammonia. Not perceiving any thing, however, in these phenomena different to what might be expected from a weak solution of nickel and cobalt in muriatic acid, I endeavoured to separate my supposed solution of Vestium into these two metals, and by means of Mr. Phillips's method, easily succeeded. Having gathered all the tested solutions that had not had other metals put into them together, I evaporated to dryness, drove off ammoniacal salts and volatile acids, separated the other acids by potash, washed the oxide, and dissolved it in muriatic acid, and then added ammonia in such excess as to dissolve the precipitate at first formed; solution of potash being then added, a precipitate fell, which was found to be nickel; a little cobalt remained in solution, and my Vestium entirely disappeared.

Dr. Vest has not said how much Vestium is contained in the nickel ore of Schladming, though the quantity is stated to be variable, and it is barely possible I may have missed the metal from its existing in very minute proportions. In following, however, the process recommended by the discoverer, I ought to have obtained it, though I do not think that process the best that could have been devised. The whole description of the metal in Dr. Vest's paper appears to be very indefinite; there is no decided and constant difference established between it and the other metals; and in examining both the regulus and its ore, obtained from Dr. Vest, I have met with no experimental evidence of its existence as a simple and new metal.

ART. X. *On the Carbonates of Ammonia and of Soda.* *By* Richard Phillips, F.R.S.E. F.L.S. M. Geol. Soc., *&c.*

DURING some late researches, my attention being directed to the composition of the carbonates of ammonia, I began, and had nearly completed, an examination of them, before I observed that they had been recently analyzed by Dr. Ure*; and I consider his results to be so nearly accurate, that I should have suppressed mine, if I had not noticed some circumstances respecting the compounds in question, which have, I believe, hitherto escaped observation. I am the more anxious to state the true nature of what is usually termed subcarbonate of ammonia, because, in my remarks upon the *London Pharmacopœia*, I have given an incorrect estimate of its composition.

My present communication will not contain any observations upon those salts which result from the direct combination of carbonic acid with ammoniacal gas; the constitution of these is well known, and they are represented, on the synoptic scale, by 49 for the carbonate, and 76.5 for the bicarbonate of ammonia. The ammoniacal carbonate, which I first examined, is that obtained by the mutual decomposition of carbonate of lime, and muriate of ammonia; it is usually called sub-carbonate of ammonia, and this appellation I shall for the present adopt.

It will appear, by the synoptic scale, that, if no loss occurred during the decomposition of the carbonate of lime, and muriate of ammonia, the carbonate of ammonia obtained would consist of—

One atom of carbonic acid......	27.54	45.62
One ditto of ammonia..........	21.50	35.62
One ditto of water	11.32	18.76
	60.36	100.

In order to compare the theoretical with the actual product of the operation, the following experiments were made:

One hundred grains of compact translucent subcarbonate of ammonia were dissolved, with the usual precautions, in dilute sulphuric acid; 54.2 grains of carbonic acid gas were evolved.

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* *Annals of Philosophy*, Vol. X. p. 203.

One hundred grains of the same salt were dissolved in water, and added to a neutral solution of muriate of lime; some effervescence was excited, and the carbonate of lime precipitated after the application of heat, and dried, weighed 86 grains; according to the scale, 63 of carbonate of lime are equivalent to 21.5 of ammonia; consequently, 86 indicate 29.3.

According to these experiments, 100 parts of subcarbonate of ammonia appear to consist of

Carbonic acid	54.2
Ammonia	29.3 leaving for
Water	16.5
	100.

By referring to the Synoptic Scale, it will be seen that the atomic constitution, and exact composition of this salt, are as follow:

3 atoms of carbonic acid	82.62	55.72
2 ditto ammonia	43.	29.
2 ditto water	22.64	15.28
	148.26	100.

On the scale it will be represented by 41.31 + 21.5 + 11.32 = 74.13, or 1½ portion of carbonic acid, one of ammonia, and one of water.

It is well known that when this carbonate of ammonia is exposed to the air, it becomes inodorous, and ceases to act upon turmeric paper. To examine the salt thus procured, the following experiments were performed:

One hundred grains of the inodorous salt were cautiously dissolved in dilute sulphuric acid; 55.8 grains of carbonic acid gas were evolved. An equal quantity of the same salt was dissolved in water, and added to a neutral solution of muriate of lime; considerable effervescence was excited, and, by heating the mixed solutions, 62 grains of carbonate of lime were precipitated; as 63 of carbonate of lime are equivalent to 21.5 of ammonia, 62 indicate 21.16. It appears, therefore, that the inodorous salt is composed of

Carbonic acid	55.80	
Ammonia	21.16	leaving for
Water	23.04	
	100.	

By the scale it will be seen, that its atomic constitution and composition are as follow:

2 atoms of carbonic acid	55.08	55.5
1 atom of ammonia	21.50	21.7
2 atoms of water	22.64	22.8
	99.22	100.

It is therefore bicarbonate of ammonia, combined with two atoms of water; on the Synoptic Scale it will of course be represented by 99.22. On considering these statements, it will be observed that, when carbonate of lime and muriate of ammonia decompose each other, the following arrangements take place:

One atom of water
One ditto ammonia, are dissipated during sublimation;
One ditto carbonic acid
One ditto ammonia, are dissipated by exposure to the air;
Two atoms carbonic acid
One atom ammonia.

Two atoms water remain in combination, forming inodorous bicarbonate of ammonia; and it is evident that the pungency of subcarbonate of ammonia depends upon the constant dissipation of carbonate of ammonia, which occurs until bicarbonate only is left.

On mentioning some of the facts now detailed to Mr. Philip Taylor, he informed me that, in attempting to prepare bicarbonate of soda in the mode recommended by M. Berthollet, he procured a salt evidently different from carbonate of soda, but too distinctly retaining alcaline properties to be considered a bicarbonate.

Upon examining this salt, I found that it consisted of minute prismatic crystals, the most regular of which appeared to consist of rhomboidal prisms, of about 60° and 120°, terminated by quadrangular pyramids, the planes of the pyramids replacing the solid angles of the prism.

This salt suffered no change by exposure to the air: the aqueous solution reddened turmeric paper strongly. One hundred grains, cautiously decomposed by an acid, gave out 40 grains of carbonic acid gas.

One hundred grains were dissolved in water, and added to a neutral solution of muriate of lime; with the assistance of heat, 64 grains of carbonate of lime were precipitated, equivalent to 39.72 of soda.

It appears, therefore, that 100 parts of this salt consist of nearly,

Carbonic acid	40.	
Soda	39.72	leaving for
Water	20.28	
	100.	

Adopting the numbers on the Synoptic Scale, it will be seen that this salt is constituted as follows:

3 atoms of carbonic acid	82.62	40.08
2 ditto soda	78.20	37.94
4 ditto water	45.28	21.98
	206.10	100.

In the second volume of the *Mémoires d'Arcueil*, p. 474, M. Berthollet has remarked the existence of carbonates of potash, and of soda, containing more carbonic acid than the carbonate, and less than the bicarbonate: he also notices Klaproth's examination of the African carbonate of soda, detailed in p. 65, Vol. II. of his *Analytical Essays*. This substance gave out 38 per cent. of carbonic acid, and lost 31 per cent. by exposure to a red heat. It is stated to consist of,

Carbonic acid	38
Soda	37
Water	22.5
Sulphate of soda	2.5
	100.

Allowing 1.5 of the water to be combined with the sulphate of soda, 100 parts of the pure salt consist very nearly of,

Carbonic acid	39.5
Soda	38.5
Water	22
	100.

It will be observed that this analysis coincides very nearly with that which I have deduced from Dr. Wollaston's scale, and it does not differ very materially from my analysis of the artificial compound.

Alluding to this native carbonate, and stating that it consists of 39 carbonic acid, +38 soda +23 water Dr. Thomson observes, (*Chemistry*, Vol. II. p. 480,) "it is evident that the African bicarbonate had lost a portion of its acid, or had never been fully saturated with carbonic acid. If we suppose this salt to be a compound of one atom of anhydrous salt, and two atoms of water, the water would amount to 19 per cent., instead of 23. If we add the four which Klaproth places to the account of the water to the acid, it would raise it to 43, which would make Klaproth's analysis approach somewhat nearer to the truth."

It appears to me, however, that, if the transfer proposed by this able chemist were made, the error would still be very considerable; the salt would then be a compound of 43 carbonic acid, and of 38 soda, whereas bicarbonate of soda consists of 43 acid, and 30.5 soda; indeed, supposing the salt ever to have been a bicarbonate, it must have lost one-fourth of its carbonic acid; but it is evident, from Klaproth's statement, that the salt which he analyzed had not suffered any change, for he remarks that the excess of carbonic acid had probably prevented efflorescence.

Mr. Faraday having obligingly supplied me with a specimen of the African salt, I found that it was distinctly crystalline in appearance, when recently broken; but the surface was not transparent, evidently from the attrition which it had undergone. The transparent salt suffered no change by exposure to the air; when moistened, it reddened turmeric paper strongly; and I found that 100 parts of it lost nearly 36.5 of carbonic acid, during solution in sulphuric acid, and it lost 30 per cent. by exposure to a red heat. It contained nearly 7 per cent. of saline and earthy impurity, which is almost five more than the salt analyzed by Klaproth, and which will in some degree account for the smaller quantity of carbonic acid which it yielded.

The experiments which I have now detailed are, I think, sufficient to shew that the salts in question are definite compounds of 3 atoms of acid, and 2 of base; or they may be regarded as compounds of the carbonate and bicarbonate; but, whatever may be the theoretical view of their composition, they will be accurately described by prefixing *sesqui* to *carbonate*, as has been already done by Dr. Thomson, with respect to the sesquiphosphate of barytes; it will, however, be proper to remark that Dr. Thomson has accidentally stated the sesquiphosphate* to be a compound of three atoms of base, and two of acid, instead of the reverse; and I notice this, because it might otherwise be supposed that I had employed the term in a sense different from that in which he evidently intended to use it.

ART. XI. *On the Figure of the Earth, as deduced from the Measurements of Arcs of the Meridian, and Observations on Pendulums.* *By* George Fisher, *Esq.*

THE figure of the earth has always been an object of interesting and important inquiry. The conclusions, however, which have hitherto been drawn from such observations as have been made for determining it, are far from affording such a satisfactory agreement in the general result, as the accuracy of the instruments and skill of the observers would have led us to expect.

The observations which I allude to are the measurements of arcs of the meridian in different parts of the world; they have hitherto (with the exception of those made in middle latitudes) been found inconsistent with an elliptical meridian; and the ratio of the earth's axes as assigned by Newton on the simple supposition of homogeneity, has been discarded to make way for other suppositions of density, which, although perhaps specimens of analytic dexterity, have been as little capable of affording us any real satisfaction as the other.

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* *Chemistry*, Vol. II. p. 475.

In determining the ratio of the earth's axes by comparing two measured arcs of the meridian in different latitudes, it has hitherto been taken for granted in the solution of the problem, that the measured lengths of arcs of the meridian, may, without any sensible error, be taken proportional to the radii of curvature at the middle points of those arcs.

The following table, however, shews the amount of error in the amplitude of the celestial arc subtending each degree of latitude, arising from this supposition:

TABLE OF CORRECTIONS.

Latitude.		Error.	Latitude.		Error.
°	°	″	°	°	″
45	45	0.2	68	22	9.3
46	44	0.7	69	21	9.4
47	43	1.2	70	20	9.7
48	42	1.4	71	19	9.9
49	41	1.9	72	18	10.3
50	40	2.5	73	17	10.4
51	39	2.8	74	16	10.7
52	38	3.2	75	15	10.8
53	37	3.5	76	14	11.1
54	36	4.2	77	13	11.3
55	35	4.6	78	12	11.4
56	34	4.9	79	11	11.7
57	33	5.2	80	10	11.8
58	32	5.6	81	9	11.9
59	31	6.1	82	8	12.0
60	30	6.3	83	7	12.2
61	29	7.0	84	6	12.2
62	28	7.1	85	5	12.3
63	27	7.5	86	4	12.4
64	26	7.8	87	3	12.4
65	25	8.2	88	2	12.4
66	24	8.5	89	1	12.5
67	23	8.6	90	0	

This table has been computed by estimating the efficacy of that part of the centrifugal force in every degree of latitude, by which a plumb line will deviate towards the southwards, from a line drawn to the earth's centre from a point on the surface, supposing the earth a perfect sphere; and the difference of these deflections at each extremity of the measured arc, will be the error in the celestial angle subtending that arc. Thus, for instance, there will be an error in the celestial arc subtending a measured degree from 66° to 67° of no less than 8″,5; from 50° to 53° of 8″,5; from lat. 45° to 46° of 0″,2 only, and at the equator and poles of 12″,5.

This accounts for Mr. Dalby's remark in the *Phil. Trans.* 1793, where he has given some calculations on measured degrees of the meridian, whence he infers that those degrees measured in middle latitudes, will answer nearly to an ellipsoid whose axes are in the ratio assigned by Newton of 229 : 230. And as to the deviation of some others, *viz.*, towards the poles and equator, he thinks they are caused by the errors in the observed celestial arcs.

If the earth be an ellipsoid of revolution, it may be conceived that since the effect of this part of the centrifugal force in urging a body towards the equator, has been duly estimated in the constitution of this solid, that a correction for this deflection will not obtain; since, from the nature of fluids, a plumb line must always be perpendicular to its surface, in order that the whole may be in equilibrio. This is true; but as the earth becomes elliptical by virtue of this centrifugal force, so will measured arcs of the meridian no longer be legitimate measures of the radii of curvature. And so long as these measured arcs are considered arcs of circles this correction for deflection will obtain. This is an instance of the " fallacia suppositio" of Bishop Berkeley, or shifting the hypothesis, for the meridians are supposed elliptical in the general solution of the problem, and afterwards, that the radius of curvature due to the middle point of a measured arc (considered as an arc of a circle) is a mean nearly between the true radii of curvature at each extremity of that arc.

Dr. Hutton, after giving a formula expressing the relation between the earth's axes, observes—" This expression which is simple and symmetrical, has been obtained without any omission " of terms on the supposition that they are indefinitely small, or " any possible deviation from correctness, except what may arise " from want of coincidence of the circles of curvature at the middle points of the arcs with the arcs themselves; and this source

“ of error may be diminished at pleasure by diminishing the mag-
“ nitudes of the arcs measured : though it must be confessed that
“ such a procedure may give rise to errors in the practice which
“ may more than counterbalance the small one to which we have
“ just adverted.”

It appears, however, that the error arising from an extension of the measured arc, is greater than that arising from want of accuracy in measuring the celestial angle subtending a smaller one, as will evidently appear from the late geodesic operations in England and France. And if

A = length of an arc of the meridian, L = lat. of the middle point of that arc, $\frac{1}{289}$ = centrifugal force at the equator (compared with gravity which = 1,)

* Then will the error in the celestial angle subtending the arc A, be $\frac{1}{289} \times \cos. 2L \times \sin. A$.

The great inaccuracy in degrees measured near the equator, or the poles, must be evident without this correction to the observed difference of latitude; and it follows that those arcs measured in middle latitudes where this correction is small, have been most correct, and agreeable to the best observations on pendulums in different latitudes. If the latitudes at each extremity of the arc be determined, and the difference of these latitudes be taken as the celestial angle subtending that arc; in latitudes between 45° and the poles, the degrees should be in excess, and between 45° and the equator in defect.

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* **Let $c=\frac{1}{289}$ the cent. force at the equator, the force of gravity being unity,**
A = arc of the meridian,
L = lat. of the middle point of that arc;
then $L+\frac{A}{2}$ = lat. of one extremity of the arc,
and $L-\frac{A}{2}$ = do. other.
Let D and *d* be the deflections at each extremity,
Then since $\sin. D=\frac{c}{2}\sin. (2L+A)$ (*Vince's Flux.* **5th edit. p. 347.**)
$\sin. d=\frac{c}{2}\sin. (2L-A)$
$\therefore \sin. D-\sin. d=\frac{c}{2}\left\{\sin. (2L+A)-\sin. (2L-A)\right\}$
$\therefore$ **by Trig^y^.** $\sin. D-\sin. d=c \times \cos. 2L \times \sin. A.$
but since D and *d* are very small arcs,
$D-d = c \times \cos. 2L \times \sin. A,$
i. e. **Error** $= \frac{1}{289} \times \cos. 2L \times \sin. A.$

Mr. Dalby further observes, (*Phil. Trans.*, 1793), that " if it be contended, that the operations at the equator and polar circle are as correct as those in middle latitudes, and that a kind of mean between the extreme results ought to be preferred ; we shall still get an ellipsoid whose axes are nearly as 229 : 230."

Let us, however, take the case of the most northern arc which has yet been measured, that in Lapland by Maupertuis, Clairault, and others in lat. 66° 20′ N., and we shall find the non-agreement of their measurement with those made in other latitudes, does not arise from want of accuracy in their measurement, but from want of the correction to the observed celestial arc.

The arc measured by Maupertuis was from Kittis to Tornea, a distance of 55023,47 toises. The star δ Draconis was observed at both places, and the difference of the zenith distances, after applying the proper corrections, was found to be 57′ 26″,9 by a zenith sector by Graham. By α Draconis it was found to be 57′ 30″,4, the mean of these is 57′ 28″,65.

Now the measured 1° (in E. fathoms) was	61194
Corr. (8″,4) per Table	—146
*Corr. for refraction	— 17
Corr^d.	61031

Here the celestial angle subtending the measured arc was determined by the difference of the zenith distances of two fixed stars δ and α Draconis, and this celestial angle observed was 57′ 28″,65, which corrected for + 8″,2 †, gives 0° 57′ 36″,85 for the corrected angle subtending the measured arc 55023,47 toises.

Likewise the 1° measured in America by Mason and Dixon in

Lat. 39° 12′ was	60628
Corrⁿ. for 2″,6 per Table..........	+45
Corr^d.	60673

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* This correction was omitted by Maupertuis ; applied by Laplace, *Méch. Cél.* tom. 2, p. 138.

† The error will be in excess or defect, according as the stars are to the north or south of the observer, in latitudes from the poles to 45° ; but in latitudes from the equator to 45° the reverse should happen.

Now by comparing these two measured arcs, *viz.*

61031 fathoms in lat. 66° 20′
60673 fathoms in lat. 39° 12′

We get the ratio of the earth's axes as 226 : 227.

And by comparing this corrected length of Maupertuis with that of Cassina and De la Caille in lat. 45° (which requires no correction), *viz.*

57285 toises in lat. 66° 20′
57028 toises in lat. 45°

We get the ratio of the earth's axes 229 : 230.

Both the same as the ratio assigned by Newton. Likewise in Liesganig's measurement there is an excess of sixteen fathoms, (upon the supposition of the earth's axes being as 229 : 230, according to Mr. Dalby's Table, *Phil. Trans.* 1793), corresponding to 1″ of the celestial arc in lat. 48° 43.

In Boscovich's measurement in 43° N., there is a defect of thirteen fathoms corresponding to 0″,8 of the celestial arc.

Mason and Dixon's measurement in North America, in lat. 39° 12 N., is reconciled in the same way; for the length of a degree, according to their measurement, is less than the computed degree, on the supposition of the earth's axes being as 229 : 230 by fifty-four fathoms, corresponding to about 3″ of the celestial arc.

I shall now refer to Colonel Mudge's conclusion (*Phil. Trans.* 1803) which is a further confirmation (if it need any) of the necessity of this correction.

" From this measurement it appears that the length of a degree of the meridian, in lat. 52° 2′ 20″ is 60820 fathoms; this conclusion is deduced from the supposition of the whole arc subtending an angle of 2° 50′ 23″,4 in the heavens, and a distance of 1036337 feet on the surface of the earth. The length of a degree at the middle point, 51° 25′ 18″ between the southern extremity of the arc and Arbury Hill, is 60864 fathoms, which is greater than the above, and exceeds it by forty-four fathoms. But this degree, admitting the earth to be an ellipsoid with the ratio of its axes, as 229 : 230 should be about ten fathoms less. If the measurement of the terrestial arc be sufficiently correct, and the earth of an elliptic form in those latitudes, either the arcs affording those deductions are incorrect, or some material deflection of the plumb line has taken place at one or two stations from the effect of attraction."—And he concludes with observing, " that the general tenor of the observations seems to prove that the plumb line of the zenith sector has been drawn towards the south; and that by attractive forces which increase as we proceed northwards.

The idea of this deflection proceeding from local attraction is at once unnecessary, as it is likewise incapable of accounting for it; for Colonel Mudge observes, " If there be an error in the amplitude of the whole arc, from a deflection of the plumb line at either station, it is not probable that such deflection existed at Dunnose[*], as a deviation of it towards the north, from a deficiency of matter towards the Channel, would tend to diminish the inequality between the two degrees. This will be evident on consideration. I am, therefore, disposed to believe, that the plumb line was drawn towards the south from the action of matter, both at the north extremity of the arc and at Arbury Hill[†], but more particularly at the first. If this were partly the case, and both Dunnose and Arbury Hill were free from such prevailing cause, the total arc must be too great if taken at 2° 50′ 23″,38, by about 8″, nearly answering to 2″ on each degree. A deviation of 8″[‡] from the true vertical is a large quantity, nor can the cause of it be assigned, unless it be supposed that the matter producing such deflection extends in a southern direction beyond Arbury Hill."

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[*] The Isle of Wight Station.

[†] The middle station.

[‡] This agrees very nearly with the computed error, for since sine error $= \frac{1}{289} \times \text{Cos. } 2\,\text{L.} \times \text{Sin. A.}$ and $\text{L} = 52^\circ\ 2'\ 20''$

$$\text{A} = 2^\circ\ 50'\ 23''$$

$$\begin{array}{rcr}
\text{Log. } \frac{1}{289} & = & -\ 3.5391 \\
\text{Log. Cos. } 2\,\text{L.} & = & 9.3860 \\
\text{Log. Sin. A.} & = & 8.6949 \\
\hline
\text{Sin. of Error } 8'',6 & = & 5.6200
\end{array}$$

M. Rodriguez, speaking of the same irregularities, observed in the French measurement from Dunkirk to Barcelona, says: " On a attribué ces différences à des attractions locales; mais en ce cas, la latitude déduite des observations faites à Barcelone aurait dû paraître moindre que par celles de Mont-Jouy même; car la déviation du fil-à-plomb ne pouvait être occasionée que par une petite chaîne élevée de 120 ou 130 toises, qui est au nord de Barcelone, dans la direction nord-ouest; la déviation devait donc être vers le nord, et elle devait augmenter les distances au zénit des étoiles circumpolaires, et partant, diminuer la latitude; mais le contraire est arrivé, car la latitude à Mont-Jouy a été 41° 21′ 45″ tandis qu'elle serait 48″,23 d'après les observations de Barcelona. Il paraît donc qu'il faut chercher ailleurs la cause de l'irregularité et cette cause ne pourra probablement se découvrir sans répéter les observations."

The discrepancies which appear in the French measurements, as well as those in England, appear far to exceed the probable errors of observation. Notwithstanding it has been conceived [*], that since the celestial angle subtending the *whole* arc in the English survey, from Clifton to Dunnose, can be reconciled to the ellipticity obtained by the French measurements, that the error must exist in the observations made at Arbury Hill, the *middle* station. M. Delambre, (*Ast.* tom. 3. p. 525), however, observes—" Il restera pourtant à concevoir comment le beau secteur de Ramsden, dont l' erreur était constante ou nulle aux deux extrémités, a pu avoir une erreur différente 5″ à la station intermédiaire."

The difference between the arc, as measured by Maupertuis in Lapland, in 1736, and Svanberg in 1805, has been *reconciled* nearly in the same way, by supposing Maupertuis to have committed an error of no less than 12″ in observing the latitude of Kettis, the northern extremity; although the latitude of Tornea, the southern extremity, was found to be precisely the same by Svanberg, as that determined by Maupertuis. The ellipticity deduced from Svanberg's measurement was $\frac{1}{307,4}$, and Maupertuis'

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[*] *Rodriguez's Animadversions*, *Phil. Trans.* 1802. *Thomson's Phil. Annals*, No. 16, p. 286.

$\frac{1}{179}$. M. Delambre, in comparing the two operations, observes: "On voit déjà, par la comparaison de la partie géodésique, que l'erreur ne viendrait ni de la base, ni des triangles. M. de Svanberg remarque lui-même que la latitude de l' Eglise de Tornéa, extrémité de l'ancien arc, est la même qu'on a trouvée en 1736; tout le mal viendrait donc des observations faites anciennement au signal de Kittis. Mais on ne voit pas clairement comment elles donneraient une erreur de 12″ sur l'amplitude. Pour la rendre moins invraisemblable, M. Svanberg rapporte les premières observations faites au Pérou où l'on voit des erreurs plus fort; mais il est aisé de répondre que le secteur dont on s'était servi d' abord au Pérou, avait de grands vices de construction. Les académiciens, à l'aide d'un horloger que les accompagnait, en construisirent de nouveaux dont on pourrait encore se défier à certain point. Au lieu que le secteur du nord avait été fait par Graham, sur le modèle du secteur de Greenwich. Ce secteur rapporté en France, a servi à Lemonnier pour vérifier la découverte de l'aberration: enfin les académiciens avaient faites des expériences directes pour s'assurer que le transport ne le dérangeait pas, tout ce qu'on pourrait reprocher à nos académiciens, ce serait de n'avoir pas retourné leur secteur de l'est à l'ouest à chaque station, parce que ce retournement leur parût trop pénible; mais on peût répondre encore que l'ayant retourné en France, ils ne trouvèrent pas que le ligne de collimation eût changé. J'ai lu attentivement un manuscrit oú Lemonnier avait consigné toutes les observations astronomiques, même celles dont on n' avait fait aucun usage, je n'y ai rien vu que pût éveiller le soupçon."

M. Delambre (*Base du Syst. Met.* Tom. III. p. 552,) has given a method of verification, by computing the amplitude of the celestial arc due to a measured one on the earth's surface, and by comparing these computed values with those observed between Dunkirk and Barcelona, has deduced an ellipticity of $\frac{1}{180}$, a result which not only cannot be reconciled to that deduced from precession and nutation, but is incompatible with the laws of gravity, for we cannot conceive an ellipticity greater than that in the case of homogeneity *. But the observations on pendulums, by M. Biot,

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* Laplace has shewn that, if the planets were originally fluids, as is na-

Mathieu, and Arago, on the same meridian, give a very different result. For M. Mathieu, from six different observations from Formentera to Dunkirk, by the method of least errors given by Laplace, has deduced an equation for the length of the form of $z+y \sin^2 L$, and by substituting the values of z and y in the six equations of condition, there is not an error greater than $\frac{3}{100}$ of a millimètre, which is at Bourdeaux; at the other places, not half that quantity. These observations give an ellipticity of $\frac{1}{298,2}$ while that obtained from the length of the arc of the meridian is $\frac{1}{180}$.

There is a similar inconsistency in De la Caille's measurement at the Cape of Good Hope, for he found the length of a degree in Lat. 30° 18′ S. to be 57,037 fathoms, corresponding to a degree in 48° Latitude in the northern hemisphere; which measurement gave rise to an idea, that the two hemispheres were not similar. This idea, however, will not at all accord with observations on pendulums. M. Mathieu has given the result of seven observations made in the southern hemisphere, from Lat. 12° to 51°, which give an ellipticity of $\frac{1}{311,5}$; and nine observations in the northern hemisphere, from Lat. 7° to 60°, give an ellipticity of $\frac{1}{323,2.}$ Now, if the amplitude of the celestial arc (of De la Caille's) be computed for an ellipticity of $\frac{1}{320}$ by Delambre's Formula, we shall find it 10″ greater than that observed.

Dr. Horsley, in his letter to Captain Phipps, observes, (after giving the ellipticity by the formula given by Clairaut from Capt. Phipps's observation on the acceleration of the pendulum at Spitzbergen :) "This is the just conclusion from your observations of the pendulum, taking it for granted that the meridians are ellipses, which is an hypothesis upon which all the reasonings of theory have hitherto proceeded. But, plausible as it may seem, I must say, there is much reason from experiment to call it in question. If it were true, the increment of the force which actuates the pen-

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tural to suppose, the limits of ellipticity are $\frac{5}{4}\,\alpha\,\phi$, and $\frac{1}{2}\,\alpha\,\phi$; or, if the polar axis be 1, the equatorial axis will be within the limits $1+\frac{5}{4}\,\alpha\,\phi$, and $1+\frac{1}{2}\,\alpha\,\phi$, where $\alpha\,\phi$ represent the centrifugal force at the equator, in terms of the force of gravity there; $1+\frac{5}{4}\,\alpha\,\phi$, in the case of homogeneity, and $1+\frac{1}{2}\,\alpha\,\phi$, where the whole of the matter is collected in the centre. *Méch. Céles.* Tom. II. p. 89.

dulum, as we approach the poles, should be as the square of the sine of latitude; or, which is the same thing, the decrement, as we approach the equator, should be as the square of the cosine of latitude. But whoever takes the pains to compare together such of the observations on the pendulum, in different latitudes, as seem to have been made with the greatest care, will find that the increments and decrements do by no means follow these proportions; in those which I have examined, I find a regularity in the deviation which little resembles the error of observation. The unavoidable conclusion is, that the true figure of the meridians is not elliptical." He then lays down a table of the results of six observations made in different parts of the world, and observes, "By this table it appears that the observations in the middle parts of the globe, setting aside the single one at the Cape, are as consistent as could reasonably be expected, and they represent the ellipticity of the earth at $\frac{1}{340}$. But when we come within 10 degrees of the equator, it should seem that the force of gravity suddenly becomes much less, and, within the like distance of the poles, much greater, than it could be in such a spheroid."

The credit due to these conclusions will be readily estimated, from the 15 observations made in different parts of the world from the equator to 66° N., selected by M. Laplace, *Méch. Célest.* Tom. II. p. 147; from these observations M. Mathieu has deduced, an ellipticity of $\frac{1}{318,96}$, and who, after finding the respective difference of each observation from the general equation, observes, "Tels sont les écarts entre la théore et les mésures du pendule décimal; ils sont certainement tous renfermés dans les limites des erreurs des observations. Le plus grand écart est de 17 centièmes de millimètre, il répond au pendule du Cap de Bonne-espérance." Out of the six observations selected by Bishop Horsley, four of them are included in the above observations selected by Laplace, viz., Bouguer, at the equator, Porto Bello, and St. Domingo; and Maupertuis in Lapland; another by Green at Otaheite, agrees nearly with other observations on pendulums in giving an ellipticity of $\frac{1}{326}$.

There is as little reason to believe, "that within 10 degrees of the poles that it becomes much greater." This conclusion is made from the single observation of Captain Phipps, in 1773, at Spitzbergen, in lat. 79° 50′ N., where the acceleration of a pendulum (vibrating seconds in London,) was found to be about 72 or 73 seconds; whereas, it was found, in the late voyage, to be 83″,36, in Lat. 79° 40′ 20″ N.

The following table shews the result of the observations on the pendulum made in the late voyage to the North Pole, taking the length of a second's pendulum in London, Lat. 51° 31′ 8″, to be 39.1386 inches, at 62° Fahrenheit, as determined by Captain Kater.

	Acceleration on mean solar time.	Latitude.	By what means.	Ellipticity.	Length.
	″	° ′ ″			
Kater.. ...	0	51 31 8N.	actual measur.	......	39.1386
Sabine....	32,86	60 10 0N.	accel. per chron.	$\frac{1}{313,8}$	39.1684
ditto....	65,23	70 26 17N.	ditto per transit.	$\frac{1}{317,9}$	39.1977
Fisher	83,36	79 40 20N.	ditto ditto.	$\frac{1}{313}$	39.2141

The equation of length deduced from the observed acceleration at Brassa Island, Shetland, in Lat. 60° 10′ N., is	$39.0080 + \text{Sin.}^2\ \text{Lat.} \times ,2131$
Do. Hare Island, Baffin's Bay, Lat. 70° 26′ 17″ N............	$39.0070 + \text{Sin.}^2\ \text{Lat.} \times ,2147$
Do. Dane's Island, Spitzbergen, Lat. 80° 40′ 20″	$39.0082 + \text{Sin.}^2\ \text{Lat.} \times ,2128$

Now, the length at Unst, the most northern of the Shetland Islands, in Lat. 60° 45′ 35″ N., was found by M. Biot (according to Captain Kater's comparison of the French metre, with Sir Geo. Shuckburgh's scale,) to be 39.17193 inches. In order to compare each of the above results with this measurement, we have

The length at Unst, from the 1st equation..........	39.17025
2d..................	39.17047
3d..................	39.17023
Mean length at Unst	39.17032
As measured by M. Biot	39.17193
Diff......	.00161

If we compute the length at Unst from the equation, 39,01162 + Sin.^{2} Lat. × ,206638 inches, deduced by the method of least squares from the measured lengths at Formentera, Figeac, Bourdeaux, Clermont, Paris, and Dunkirk, by M. Biot, Arago, and Mathieu, on the French arc,

The length at Unst will be 39.16895
As measured by M. Biot........................ 39.17193

Mean...... 39.17042
Mean length at Unst, from the three equations...... 29.17032

Diff...... .0001

The near agreement of these observations not only between themselves, but with others made in lower latitudes with pendulums, both with and without a maintaining power, little accords with the remark of Bishop Horsley; and, indeed, the general tenor of all observations on pendulums seems to prove (contrary to what has hitherto been concluded from the measurement of arcs of the meridian,) the meridians are strictly elliptical, or, at least, that the observed differences from the elliptic hypothesis are within the limits of the errors of observation; and the length of a pendulum, vibrating seconds in any latitude will be $\overset{\text{Inches.}}{39.0082} + (\text{Sin. Lat.})^2 \times \overset{\text{Inches.}}{,2128}$, at 62° Fahr. on Sir Geo. Shuckburgh's Scale.

M. Mathieu has deduced, by means of the theory of Laplace, from the observations of M. Ciscar (with a pendulum without a maintaining power, taken out of the Spanish frigates la Descubrerta and L'Atrevida,) made in nine different latitudes in the northern hemisphere, an ellipticity of $\frac{1}{323,2}$, and from seven observations in the southern hemisphere an ellipticity of $\frac{1}{311,5}$. The mean between these coincides nearly with the results deduced from Clairault's *Theorem* (2d Part, Figure de la Terre,) $\frac{P-\Pi}{\Pi} = 2\varepsilon - \delta$, from the observations in the Arctic Regions, P representing the polar force, Π the equatorial, δ the true ellipticity, and ε the ellipticity of the homogeneous spheroid. That given by Laplace, *Méch. Céles.* Tom. I. p. 102, is $\frac{P-\Pi}{\Pi} + \delta = \frac{5}{2}v$, where v = centrifugal force at the equator, force of gravity being unity. Expressions which evidently coincide, since in the homogeneous spheroid, $\varepsilon = \frac{5}{4} v + \frac{5}{224} v^2 -$ &c.

M. Mathieu, after computing the respective errors of the observations of M. Ciscar, from the elliptic hypothesis, observes, "Ces différences sont si petites, qu'elles montrent à la fois le grand accord des expériences entr'elles et avec la théorie ; il n'y en a qu'une que s' élève seulement à deux dixièmes de millimètre ?"

Although these conclusions have not all of them been deduced from absolute measurements of pendulums at the different places, but the lengths computed from the observed difference in the vibrations of the same pendulum, when transported to those places; yet it fortunately happens the ellipticity does not so much depend on the absolute as the relative lengths, as will be evident on considering the equation expressing the ellipticity. And if the length be known in any given latitude to a tolerable degree of accuracy, by actual measurement, the length in any other latitude may be estimated in terms of this measurement, by the observed difference in the number of vibrations, without involving the errors of measurement.

Art. XII. *A few Facts relating to Gas Illumination.*

The producing from coal an aëriform fluid, which could be distributed at pleasure in every direction, for the purpose of economical illumination, has justly been ranked amongst the greatest benefits which the science and enterprise of this country has conferred on mankind.

Important as this discovery was, many defects and inconveniencies have arisen on its adoption; coals contain a large proportion of sulphur, which is volatilized with the gas, and it has hitherto been found impossible to purify it sufficiently for lighting close rooms. The suffocating smell, and the property which it has of tarnishing every thing metallic, exclude its use from dwelling-houses, on account of the injury it would do to our health, our furniture, books, pictures, plate, paint, *&c.* At the same time that the gas which *affords light* is produced from coal, another gas (hydrogen) is also formed and mixed with it in a large proportion, which on being ignited occasions great heat without adding to the light; these effects render coal gas unpleasant in sitting rooms, and have nearly confined its use to open shops and street lamps.

It is now generally found that the sulphuretted hydrogen which is often mixed with coal gas, very rapidly destroys and stops up the smaller pipes which are used for its conveyance, and much inconvenience and risk is the consequence, especially when it is introduced into buildings. The apparatus necessary for the production of coal gas is very large, expensive, and unmanageable—the purification, imperfect as it is, very troublesome—and the residual matter is peculiarly offensive. This confines its adoption to public companies, or large establishments, thereby materially limiting its utility, and producing an injurious monopoly. The employing of coal instead of oil for the purpose of illumination, has an injurious effect on one of the most important branches of trade a maritime country can possess; and in proportion as coal gas is used, our Fisheries are injured.

About two years since it occurred to Messrs. John and Philip Taylor, that it might be practicable to construct an apparatus capable of converting oil into gas, which would be preferable to coal gas for lighting houses.

In theory, the project appeared easy, and the first experiments were flattering; but, on trying the plan on a more extensive scale, numerous practical and chemical difficulties occurred, which have been removed by considerable labour and expense.

The apparatus is now rendered effective and unobjectionable, and has received the approbation of the first men of science in this and other countries*.

The advantages of oil gas, when contrasted with coal gas, are as follow;—the material from which it is produced containing no sulphur or other matter by which the gas is contaminated, there are no objections to its use on account of the suffocating smell in close rooms. It does no sort of injury to furniture, books, plate, pictures, paint, *&c.* All the costly and offensive operation of purifying the gas by lime, *&c.*, is totally avoided when it is obtained from oil. Nothing is contained in oil gas which can possibly injure the metal of which the conveyance pipes are made.

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* In our next Number we hope to lay before our readers a complete account of the most improved oil-gas apparatus.

The oil gas containing no unmixed hydrogen, (which occasions the great heat of coal gas), there is no greater heat in proportion from the flame of oil gas than from burning oil in lamps, wax candles, *&c.*

The apparatus for the production of oil gas is much less expensive than that necessary to make coal gas; it occupies much less space—it requires much less labour and skill to manage it—it is not so liable to wear and tear, and not so costly to repair as a coal gas apparatus—there are no offensive products to remove, and on its present improved construction it may be introduced into any dwelling-house without nuisance.

The economy of light from oil gas may be judged of from the following data:—

One gallon of common whale oil will produce about 90 cube feet of gas, and an Argand burner will require a cube foot and half per hour to maintain a perfect light; consequently, a gallon of oil, made into gas, will afford such a light for sixty hours, and the expense at a moderate price of oil will be, allowing for coals, labour, &c., not more for one burner than three farthings per hour,

Such a burner will be equal in intensity of light to two Argand oil lamps, or to ten mould candles.

The expense of Argand oil lamps is usually admitted to be about 1½*d.* per hour each.

Supposing 10 mould candles to be burning (at 4 to the lb. will be 2½ lb. costing 2*s.* 11*d.*) $\frac{1}{10}$ part will be consumed in each hour, and the cost of the light is then 3½*d.* per hour.

If wax candles be employed, the expense of a quantity of light equal to a gas burner for one hour, by the same mode of reckoning, allowing a candle to burn ten hours, and taking the price of wax candles at 4*s.* 6*d.* per lb. will cost about 14*d.*

The account will therefore stand thus—

Argand burner oil gas, per hour	¾*d.*
Argand lamps spermaceti oil	3*d.*
Mould candles	3½*d.*
Wax candles	14*d.*

In many cases it may be desirable to use a much smaller quantity of light, than such a burner as the one above calculated upon might produce; and instead of the light of ten candles, that of one or more may be given by using burners of a different description, and the expenditure of gas, and the cost, will be reduced in proportion.

The oil gas has a material advantage over coal gas, from its peculiar richness in olefiant gas, which renders so small a volume necessary, that one cube foot of oil gas will be found to go as far as four of coal gas. This circumstance is of great importance, as it reduces in the same proportion the size of the gasometers, which are necessary to contain it; this is not only a great saving of expense in the construction, but is a material convenience where room is limited.

The calculations on the cost of light from oil gas are taken on the usual price of good whale oil; but it is to be observed that cheaper oils will answer the purpose nearly as well, and many of these are often to be procured, and the whole expense may be materially lessened by their use.

In the course of their first experiments, Messrs. John and Philip Taylor were surprised to find that the apparatus they employed gradually lost its power of decomposing oil, and generating gas. On investigation, they discovered that the metallic retorts which had originally decomposed oil and produced gas in abundance, ceased in a very great degree to possess this power, although no visible change had taken place in them.

The most perfect cleaning of the interior of the retort did not restore the effect, and some alteration appears to be produced on the iron by the action of the oil, at a high temperature.

Fortunately the experiments on this subject led to a most favourable result, for it was found that by introducing fragments of brick into the retorts, a great increase of the decomposing power was obtained, and the apparatus has been much improved by a circumstance which at one time appeared to threaten its success.

A small portion of the oil introduced into the retort still passed off undecomposed, and being changed into a volatile oil, it carried with it a great portion of caloric, which rendered the construction of the apparatus more difficult than was at first anticipated; but by the present arrangement of its parts, this difficulty is fully provided for, and the volatilized oil is made to return into the oil reservoir, from whence it again passes into the retort, so that a total conversion of the whole into gas is accomplished without trouble, or the escape of any unpleasant smell.

The only residuum in the retort is a small quantity of carbon, and the only products besides the gas are a minute quantity of sebacic and acetic acids, and a portion of water—all which are easily separated by passing the gas through a vessel containing water.

The superiority of the light from oil gas over other artificial lights, is fully shewn by its rendering the delicate shades of yellow and green nearly as distinct as when viewed by solar light.

Mr. De Ville, of the Strand, who has made many important experiments and observations on gas illumination, with a view of applying it to light-houses, is inclined to estimate the average produce in gas of a gallon of oil, at eighty cubical feet.

A single jet burner, giving the light of two candles and a half, consumes half a cubical foot of gas per hour.

A double jet consumes three quarters of a foot to give twice the above light, and a treble jet requires one foot.

The light of an Argand burner of coal gas, compared with one of spermaceti oil, may be estimated as 2½ to one; and of oil gas to coal gas, as 9 to 5.

A curious fact respecting Argand's burners for gas, is, that those with few holes consume a comparatively larger quantity of gas than those having a greater number:—thus,

A burner with	15 holes consumes	2⅛ cubic feet per hour.
Ditto	12 ditto	2¼ ditto
Ditto	10 ditto	2½ ditto

The holes being of the same dimensions in each burner.

On the important subject of coal-gas two treatises have just appeared, which contain much valuable information. One of these is by Mr. Accum, whose former publication is probably well known to such of our readers as may be concerned in this branch of inquiry. The present may be considered as a new work, superseding the former, and abounding in practical details which the author's extended experience has put him in possession of. It is illustrated with seven useful plates.

After pointing out the nature and advantages of the art of procuring light from coal-gas, Mr. Accum gives an account of the different kinds of coal employed in Great Britain, and of their relative value for producing gas; he then treats of the form and dimensions of the retorts, and of the management of the distillatory process. We were here surprised to find so favourable an account of Mr. Clegg's horizontal rotary retorts, a description of which, furnished by that gentleman, will be found in the 2d volume of this Journal. We say surprised, from having been informed of the total failure of the plan at the Westminster gas-works, although erected under the inventor's superintendence; whereas, it now appears to have been carried into execution at Chester, Birmingham, and Bristol, and to be employed at the Royal Mint under the direction of Mr. Accum.

The 8th part of the author's treatise relates to the apparatus, and means of purifying gas; and in the 9th chapter he treats at length of gas-holders, or, as we have generally been in the habit of calling them, *gasometers*. A curious collapsing gas-holder, contrived by Mr. Clegg, is here described, especially applicable in those cases where difficulty attends the construction of a well, or tank, for the usual gasometer to work in. It requires a sheet of water no more than 18 inches deep.

Mr. Accum then proceeds to describe the *gas-metre*, a very curious and useful invention, derived also from the ingenuity of Mr. Clegg. It is a cylinder so constructed as to be kept revolving upon its axis, by the passage of the gas through it, the number of its revolutions depending upon the quantity of gas which goes through its various cavities in a given time; so that if is a self-acting register, which, if placed between the purifying vessels and the gasometer, shews the quantity of gas generated daily; and if between the gasometer and the mains, it tells the quantity of gas which is consumed by the burners, or otherwise disposed of.

The remaining sections treat of the pipes, burners, and a variety of other minor, but important subjects.

Mr. Peckston's work on gas illumination also abounds in useful details. It treats of the theory of the production of artificial light, the cost of various modes of obtaining it, the natural history of pit-coal, its various combinations and uses, especially in the production of gas. In this volume there are also fourteen useful plates, and the author seems to have attained the object he had in view, that of describing plainly and methodically every part of the gas-light apparatus, so as to enable any one acquainted with machinery to erect such, either for supplying his own premises with gas, or for lighting up manufactories, streets, or towns.

In both these treatises we are glad to find concise, but explicit directions to workmen, for the erection and construction of different parts of the apparatus; with much theoretical knowledge there are abundant practical details; and though Mr. Accum and Mr. Peckston widely differ upon certain minor points, they agree in their principal conclusions. If we understand rightly, Mr. Accum prefers *cylindrical*, and Mr. Peckston *elliptical* retorts. The latter, in his chapter on the *gas-meter*, has discussed, at some length, the title of Mr. Clegg to its invention, and considers the *gas-meter* contrived by Mr. Malam as not only an original invention, but as infinitely preferable, which it really appears to be, to the prior contrivance of Mr. Clegg.

These works on the manufacture of coal-gas will not only be found useful to those who wish to avail themselves practically of their contents, but they abound in statements and information which will probably interest a much more numerous class of general readers.

Art. XIII. *Outline of a Theory of Meteors.* By Wm. G. Reynolds, *M.D. Middletown Point, New Jersey.*

[The following paper is from the *Quarterly Journal of Science*, edited by Dr. Silliman, at New York. We have republished it in the hope that it may call the attention of our readers to the very interesting and curious subject of which it treats, and in the expectation of its inducing some of our Correspondents to resume the discussion. We do not consider the hypothesis of Dr. Reynolds as the most happy that has been invented to account for the production of meteoric bodies, though it appears to us quite as plausible as the idea that they are of lunar origin, a notion sanctioned by some eminent mathematicians and meteorologists. Ed.]

Should the progress of science, for a century to come, keep pace with its rapid advancement for the last fifty years, many appearances in the physical world, now enveloped in obscurity, will then admit of as easy solution as the combustion of inflammable substances, or any familiar process in chemistry, does at this day. Among the many subjects from which the veil of mystery would thus be raised, we may include those luminous appearances in the aërial regions, called meteors, which I am about to consider in the following essay; and which seems to constitute a distinct class of bodies of considerable variety.

Meteors were regarded by the ancients as the sure prognostics of great and awful events in the moral and physical world; and were divided by them into several species, receiving names characteristic of the various forms and appearances they assumed; but of their opinions, as to the physical cause of these phenomena, the ancients have left us nothing solid or instructive. The moderns, more enlightened, have ceased to regard these bodies with the superstitious awe of former ages; but in respect to the cause thereof, are perhaps but little in advance of their predecessors, having, I believe, produced nothing yet that will bear the test of philosophical investigation.

Doctor Blagden (*Philosophical Transactions*, 1784,) considers electricity as the general cause of these phenomena; Doctor Gregory, and others, think they depend upon collections of highly inflammable matter, as phosphorus, phosphorated hydrogen, *&c.*

being volatilized and congregated in the upper regions of the air. Doctor Halley ascribes them to a fortuitous concourse of atoms, which the earth meets in her annual track through the ecliptic; and Sir John Pringle seems to regard them as bodies of a celestial character, revolving round centres, and intended by the Creator for wise and beneficent purposes, perhaps to our atmosphere, to free it of noxious qualities, or supply such as are salutary. Many other theories, as ingenious as fanciful, might be enumerated; but without commenting on their comparative merit, I must acknowledge that none of them have yet impressed my mind with a conviction of their truth. A series of observations, however, have enabled the moderns to ascertain, with apparent accuracy, several particulars relative to these stupendous bodies, which add much to our knowledge of their general character:—their velocity, equal to 30, and even 40 miles in a second of time; their altitude, from 20 to 100 miles; and their diameter, in some instances, more than a mile, are facts we derive from respectable authority, and may aid us, essentially, in forming just conceptions of their nature and properties.

I believe meteoric stones to result from all meteoric explosions; limiting, however, the term meteor, to those phenomena, in the higher regions of the air, denominated fire-balls, shooting-stars, *&c.* That these bodies move in a resisting medium, must be evident to every attentive observer; and that this medium is our atmosphere, is pretty certain, 1st. Because we know of no other resisting medium round the earth; 2dly. Because the same kind of resistance is apparent at every intermediate altitude, from their greatest to their least, which last we know to be far within our atmospheric bounds; and, 3dly. Calculation has, in no instance, assigned them an elevation beyond the probable height of the atmosphere.

That meteors proceed from the earth, that they arise from certain combinations of its elements with heat, and that meteoric stones are the necessary result of the decompositions of these combinations, are opinions I will endeavour to support, by the following considerations.

1st. The properties and habitudes of matter, under certain conditions and combinations.

2dly. The situation of the earth's surface in respect to the sun, the influence of his rays thereon, and the nature of the elements or compounds on which these rays act:

And, 3dly. The identity that exists between the component parts of meteoric stones, and the elements that enter abundantly into the composition of our globe; and, by several other facts and arguments.

Under my first general specification, I will select such principles from the established doctrines of philosophy, as have an immediate bearing on the subject; without engaging in any of those subtle speculations in which certain recondite properties of matter, or the identities of quality and body are affirmed or denied.

Thus, 1st. Heat is the universal cause of fluidity and volatility in bodies; hence no solid can assume the state of gas, until it absorbs, or unites with, a certain portion of caloric; and the subtilty and volatility of compounds thus formed, will be in a due ratio to the quantity of caloric they employ.

2dly. The heat employed to maintain a body in the gaseous state, is said to be latent or fixed, and may be regarded as an ocean or atmosphere of fire, holding the ultimate particles of the body in a state of extreme division, and wide separation, from which they can be driven only by some change in the affinities or condition of the compound.

3dly. If the latent heat in a gaseous compound be suddenly abstracted, as in explosion, its escape is attended with the emission of light and sensible heat, when the volatilized particles held in solution being no longer able to maintain the state of gas, suffer approximation in a due proportion to the quantity of caloric they have lost.

4thly. Caloric, in reducing solids to the state of gas, lessens, but cannot in any case, as far as we know, totally destroy their gravitating force; the diminution of this force, however, being in a direct proportion to the quantity of heat employed.—Hence the following inferences may be fairly drawn, as they seem to be in unison with the relative dependence and harmony existing between the material elements of this globe, and, I believe, are contradicted by no direct experiments; *viz.*, that the expansion of volume, specific levity, and subtilty of artificial gases, are in a direct proportion to the absolute quantity of caloric they employ; and the caloric is in the same proportion to the insolubility of the substance with which it unites.

5thly. When the specific gravity of bodies on the surface of the earth, is reduced below that of the superincumbent atmosphere, they ascend to media of their own density, in obedience to the laws of aërostatics; thus we raise balloons by filling them with light air, and the carbon of pit-coal and common wood exposed to combustion, and water to the sun's rays, will rise until they reach a medium of like specific gravity with themselves.

6thly. Mechanical agitation and division assist the solution of solids, by bringing fresh portions of the menstruum into successive contact with their fragments, and thus exposing a larger surface.

Under the second head, I proceed to notice the situation of the earth's surface in respect to the sun, &c. The atmosphere is a thin, elastic, gravitating fluid, that completely envelops the earth, to which it may be considered a kind of appendage or external covering; its base, resting on the earth's surface, is of an uniform density, growing rare as it recedes therefrom, in a due ratio to the diminution of its gravitating force, until it is lost in empty space. The atmosphere is estimated on certain data to be about 44 or 45 miles high, but we have good reasons to believe it fills a much wider circle, though too thin to reflect the rays of light above its reputed height.

The earth presents one whole hemisphere to the sun in unerring daily succession; and those parts of it which have the least protection against his rays, will, *cæteris paribus*, suffer the greatest intensity of their action. Within the tropics, the atmosphere opposes less resistance to the sun's rays than in the temperate zones; and in both, large tracts of cultivated land, the summits and sides of great ranges of mountains, margin of oceans, rivers, *&c.*, present an almost naked surface to their influence*. The exterior strata of the earth, and especially the more exposed parts thereof, envelop in their compounds elements of an identity of character with those composing meteoric stones.

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* Here we might properly enough notice the high-ways, streets, and pavements of cities, *&c.*, on which the materials being minutely divided

The atmosphere is the great recipient of all volatilized bodies; it possesses but feebly the powers of a solvent, unaided by heat or moisture, but when these are adjuvants, no body in nature can totally resist their action for a long time.

Now if the above principles are admitted, we have in their application a reasonable solution of most meteoric phenomena. Thus, the rays of the sun darting through the atmosphere reach the surface of the earth, where, by accumulation, they produce sensible heat, which though not intense, is steady and uniform, for many hours every day; minute portions of the earthy and metallic compounds exposed to the sun's influence, will be volatilized by the absorption of heat, and thereby assuming the state of elastic fluids, will ascend until they arrive at media of their own density. The atmosphere in contact, will have some of its particles blended in these compounds, will ascend with them, and to supply the vacuum, new portions of air will rush in and ascend, and the process will continue until the sun's rays are withdrawn, or interrupted by some of the common occurrences of nature.

The utmost height to which these elastic fluids ascend, may be estimated at something more than one hundred miles; and they float at every intermediate distance between their greatest elevation and the clouds, but rarely below the latter, except their course is directed towards the earth in their explosions. They probably ascend at first in small daily detached portions of gaseous clouds, and are diffused over wide regions; but having no sensible resistance opposed to their mutual attraction, they will by the laws of their affinities congregate into immense volumes of highly-concentrated elastic fluids, which on exploding will exhibit all the phenomena of bursting meteors, in the following manner, *viz.*, the latent heat on escaping will manifest itself

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by attrition, are in a better state for the sun to act freely on, and will consequently yield greater products than equal areas of undisturbed surface, under like circumstances of heat.

in the form of fire and light, the force with which it strikes the atmosphere, or the rebound of the latter to fill the vacuum, or both, will occasion sound more or less detonating or hissing, as the escape is more sudden, or the atmosphere more dense; the earthy and metallic particles on the escape of caloric, will obey the laws of cohesive attraction, clash together, recover their gravity, and descend to the earth in masses, or shattered fragments.

Meteoric stones frequently bear the marks of violence, which is doubtless owing to the conflict sustained at the moment of explosion; their difference in size depends on the difference of magnitude in the disploding volumes; something like regular arrangement is frequently perceived in the structure of these stones, because in all productions of solid from fluid matter, the consolidating particles possess a tendency to arrange themselves in the order of their affinities. It is thus the various arrangements in saline crystallization, the freezing of water, and cooling of melted metals, may be accounted for. There is a real, as well as an apparent difference in the velocity of meteoric bodies; the first arising from their difference of magnitude and the violence of the explosion, as well as from the resistance they meet; the latter, from the different distances at which they are seen. The gradation of colour, from a bright silvery hue to a dusky red, is owing, in a certain degree, to the state of the atmosphere refracting different coloured rays, and also to the materials in the compound, similar to the different hues in artificial fireworks. Reddish and white nebicula are sometimes left in the tracks of meteors, which are nothing but ignited vapours, or the particles brushed off the burning body by the resisting atmosphere. The velocity or motion and direction of meteors, depend upon principles well known and daily practised by engineers, and the constructors of fireworks.

The immediate cause of these explosions is a little obscure, and merits a fuller detail than is compatible with my present limits; their analogy to the electric phenomena in the clouds, leaves room to suppose they are effected by certain modifications of electricity. Clouds of opposite electricities will approach each other, and explode, by the positive imparting as much electrical fire to the negative cloud as will make them equal, when just as much water as the imparted fire held in solution, will be set at liberty and descend to the earth. If, however, this solution be deemed inapplicable, perhaps the following may be admitted. Thus, when heat is urged upon incombustible * bodies with a force that overcomes the cohesive property by which their particles are tied together, it unites with them in large quantities, and becomes latent, by which union they are reduced to the state of elastic fluids; and as it is a universal property of heat to counteract the gravitating force of bodies, these compounds must necessarily become volant, and ascend as above stated. It is only thermometrical or sensible heat, that destroys the attraction of cohesion existing between the particles of bodies, the repulsive power of latent heat being barely able to counteract this property, when the elements under its dominion are removed beyond a certain distance from each other; now the very reduced temperature in the high regions to which these gaseous clouds will ascend, may admit their earthy and metallic particles within the sphere of cohesive or aggregative attraction, when the caloric will be expelled like water from a sponge, accompanied by all the phenomena above stated.

The third general head of my subject leads me to inquire into the constituent principles of meteoric stones: sundry papers on the analysis of these productions, have been furnished us by chemists of acknowledged reputation and ability, and in none of these that I have seen, was there any element described that had not been previously known. But should it hereafter be found that air stones contain matters not found on our globe, the fact will afford no absolute proof of the foreign origin of these stones, as we are successively discovering earthy and metallic principles of distinct characters from those already known.

A portion of one of these stones that fell in the town of Weston,

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* Perhaps there is no body in nature absolutely incombustible, but I use the term here in common acceptation.

(Connecticut) examined by the late Dr. Woodhouse, gave the following results in a hundred parts, *viz.*

Silex	50	
Iron	27	
Sulphur	7	
Magnesia	10	
Nickel	1	inferred from chemical tests.
Loss	5	
	100	

" The sulphur was seen by the naked eye distributed through the silex in round globules the size of a pin's head, after dissolving the powdered stone in diluted nitric acid."

All specimens of these stones do not afford precisely similar results, but differ in their constituent elements and relative proportions; their component parts, however, are to be found abundantly in schist, schorl, pyrites, pebble, granite, *&c.*, on which the sun must daily act*.

The following facts go to strengthen the above theory, *viz.* Meteors are most frequent and stupendous in tropical countries, where the heat of the sun is most intense; and less frequent in our climate in the winter and spring, while, and after the earth has been covered with snow for many weeks in succession; and they are most frequent in the higher latitudes towards autumn, after a continuation of hot dry weather; out of the whole number (179) of shooting stars I have noted during the last twelve years, 149 appeared between June and December, inclusive.

If it be said that the specific gravity of meteoric stones being several times that of water, it is absurd to suppose they can rise, (if even reduced to the state of gas), to the elevated stations here assigned them, seeing the vapours of water can ascend only one or two miles above the earth. To this I reply, that the doctrine of heat is not yet so thoroughly understood, as to acquaint us with all its habitudes with natural bodies, but we infer from analogy, that the more refractory a body is in the fire, the greater in a due ratio is the absolute quantity of heat required to reduce it to, and retain it in, the state of gas; and the greater, in a corresponding degree, will be the dilatation of its particles and decrease of its specific gravity. Hence, if water, reduced to vapour by heat, be capable of assuming an altitude of two miles, it follows that more refractory substances, reduced to a similar state, will suffer expansion and fugacity in a due proportion to the quantity of caloric they employ, and will assume a corresponding elevation, as already inferred under my first head.

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* [Dr. Reynolds here seems to forget *nickel*, which may be regarded as characteristic of meteoric stones. Ed.]

Another objection may be, that though high degrees of heat affect certain solids as above stated, yet these cannot be sensibly acted on by such feeble agents as atmospheric air and the rays of the sun. I answer, if it be admitted that sensible heat acts on solids in an increasing ratio to its intensity, it follows that lower degrees, though acting in an inverse ratio to higher, must affect the same bodies in a conceivable degree at any temperature above their natural zero*; and though the heat of the sun beating on a plane surface for several hours is feeble, compared with that produced by a burning lens, or air furnace, yet if it be sufficient to detach from one square foot of the earth's surface the 104023 part of a grain in twenty-four hours, the quantity taken from 100 square miles, in the same time and proportion, would amount to ten pounds, which is abundantly sufficient for all meteoric phenomena; and the loss to each square foot, supposing the process to be uninterrupted, would be no more than one grain in 284 years. When we advert to the intense heat produced by concentrating a few of the sun's rays in a burning lens, the whole quantity daily sent to the earth must strike us forcibly. If collected in a lens of sufficient magnitude, they might volatilize a space equal to the state of New York in a moment of time! As all bodies possess a limited capacity for heat, does it not follow that there must be some outlet to its perpetual accession to our globe, or the earth would soon become so highly ignited as to glow with the fulgour of a meteor? And may not this outlet be found in the above described compounds? which serve as conductors of the surplus of heat from the earth to the higher regions of the air, where on being freed by displosion, from the grosser matters encumbering it, it finds a rapid passage to its great archetype and parent, the SUN. Thus his daily waste may be restored, and an equilibrium, by the return of his own emanated particles, preserved between the sun and the earth, and probably all the planets of our system.

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* "It may be easily proved that water evaporates (though slowly) at a temperature many degrees below its freezing point; and these vapours are more subtle and elastic than those formed at the boiling point of that fluid.

REMARK.

"It is indeed proved that vapour is formed from water at the lowest temperature, but is *less elastic*, the lower the temperatures, as appears from its sustaining a continually-decreasing column of mercury, the lower the temperature at which the vapour is formed. Vide *Dalton's* and *Gay Lussac's Experiments. Editor*."

The last consideration I shall offer in favour of the domestic or earthly origin of meteoric phenomena, is the difficulties that present to our granting them a foreign one. Though I am well aware of the respectability of the names which the theory of moonstones can summon to its support, yet I have always regarded it as unfounded and unphilosophical for the following reasons, *viz.* 1st. Whether the moon has an atmosphere or not, we must all admit that she has attraction, which must extend to many thousands of miles from her surface. No projectile force that we are acquainted with can throw a heavy body 100 miles, even though no atmospheric, or other resistance than its own gravity, were present; hence the idea of that force extending to thousands of miles from the moon's surface, is gratuitous and nugatory. 2dly. The products of volcanoes bear no similarity of origin, or kindred resemblance to meteoric stones; those are lavas of different kinds, pumice-stone, scoria, ashes, *&c.* these, solid masses of matter, with some degree of regularity in the arrangement of their constituent particles. 3dly. The descent of these stones has no coincidence in point of time with the position of the moon. She is as often in their nadir as their zenith. We also witness in all cases, explosion and light in our own atmosphere, at the time of the descent of these stones. This could not be the case if they proceeded from the moon, for obvious reasons. 4thly. The heat adequate to such projectile force as would carry a body from the moon's surface beyond the sphere of her attraction, would volatilize the matter of meteoric stones in a moment; hence they would not be projected from the lunarian crater in solid masses, but in elastic vapour.

In conclusion, although the theory which I have endeavoured to elucidate and establish, be subject to some difficulties and objections which science may hereafter remove, it appears to me perfectly consonant with the relative dependence and harmony of our system, and by no means at variance with the infinite wisdom and power by which it was originated.

ART. XIV. *Cursory Observations on the Geography of Africa, inserted in an Account of a Mission to Ashantee, by* F. Edward Bowdich, *Esq., demonstrating the Errors that have been committed by European Travellers in that Continent, from their ignorance of the African Arabic, the learned and the general travelling Language of those interesting Countries, by* James Grey Jackson, *Esq.*

Page 157. " THE Niger after leaving the Lake Dibbir was invariably described as dividing in two large streams."

The Lake Dibbir (vide page 187 of Bowdich's *Account of a Mission to Ashantee*) is called in the proceedings of the African Association, Dibbie, but the proper appellation is El Bahar Tibber, or El Bahar Dehebbie : the Bahar Tibber signifies the sea of gold dust; the Bahar Dehebbie signifies the sea, or water abounding in gold. Jinnee, which is on the shore of this sea or lake, abounds in gold, and is renowned throughout Africa for the ingenuity of its artificers in that metal, insomuch that they acknowledge the superiority of Europeans in all arts except that of gold work. There are some specimens of Jinnee gold trinkets very correctly delineated in the recent interesting work of Lieutenant Col. Fitz-Clarence. (*Journal of a Route across India, through Egypt to England*, page 496.)

Page 187, " Yahoodie, a place of great trade."

This is reported to be inhabited by one of the lost tribes of

Israel, possibly an emigration from the tribe of Judah. Jahooda in African Arabic signifies Judah; Jahoodee signifies Jew.

Page 189, " Mr. Beaufoy's Moor says that below Ghinea is the sea, into which the river of Timbuctoo discharges itself."

This might have been understood to signify the sea of Sudan, if the Moor had not said *below* Ghinea, (by which is meant Genowa, or as we call it Guinea,) which implies that the Neele Elabeed (Niger) discharges itself in the sea that washes the coast of Ghinea; this therefore corroborates Seedy Hamed's, or rather Reichard's hypothesis.

Page 190, " This branch of the Niger, passing Timbuctoo, is not crossed until the third day going from Timbuctoo to Houssa."

This quotation from Dapper's description of Africa is corroborated by L'Hage Abd Salam Shabeeni, whose narrative says, " Shabeeni after staying three years at Timbuctoo, departed for Houssa, and crossing the small river close to the walls, reached the Neel in three days, travelling through a fine populous cultivated country." The confusion of rivers, made more equivocal by every new hypothesis, receives here additional ambiguity. If there were, as Mr. Bowdich affirms there are, three distinct rivers near Timbuctoo, *viz.* the Joliba, the Gambarro, and the Niger (*i. e.* Neele Elabeed) how comes it that they have not been noticed by *Leo Africanus* who resided at Timbuctoo; by *Edrissi*, who is the most correct of the Arabian geographers; or whence is it that these rivers have not been noticed by the many Moorish merchants who have resided at Timbuctoo, and whom I have questioned respecting this matter*; whence is it that Alkaid L'Hassen Ramy, a captain in the Emperor of Morocco's negro guards, and a native of Houssa, with whom I was intimate, knew of no such variously-inclined streams. This being premised, I am not disposed to alter the opinion I brought with me from Africa the beginning of this century, which is, that the Neel Elabeed is the only mighty river that runs through Africa from West to East; but I admit that its adjuncts have different names, as itself has; thus in the manuscript of Mr. Park's death, a copy of which is inserted in Bowdich's Ashantee, it is called *Kude;* many hundred miles eastward it is called *Kulla*, from the country through which it passes; but Kude and Kulla are different names, and ought not to be confounded one with the other; neither ought Quolla (*i. e.* the negro pronunciation of Kulla) to be confounded with Kude, the former being the negro term for the same river, in the same manner as Niger is the Roman name for the Neel Elabeed.

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* The Arabs, who form the stata or convoy of the cafilahs or caravans which cross the Sahara, are often seen at Agadeer, and sometimes at Mogodor; and if there were a river penetrating to the north through the Sahara, it unquestionably would have been noticed by them: such a prominent feature in African travelling as a river of sweet water passing through a desert, could not, I imagine, have failed of being noticed by these people.

There is a stream or river which proceeds from the Sahara, the water of which is *brackish*; this stream hardly can be called a river, except in the rainy season; it passes in a south-westerly direction close to Timbuctoo, but does not join the Neel el Abeed. I could mention several intelligent and credible authorities, the report of respectable merchants, who have resided at Timbuctoo, in confirmation of this fact; but as the authorities which I should adduce would be unknown to men of science in Europe even by name, I would refer the reader to the narrative of an intelligent Moorish merchant, who resided at Timbuctoo three years, and who was known to the Committee of the African Association. This travelling merchant's name is L'Hage Abdsalem Shabeeni; and his narrative, a manuscript of which, with critical and explanatory notes by myself, I have in my possession, has the following observation:

"Close to the town of Timbuctoo, on the south, is a small rivulet, in which the inhabitants wash their clothes, and which is about two feet deep; it runs into the great forest on the East, and does not communicate with the Neel, but is lost in the sands west of the town; its water is brackish—that of the Neel is good and pleasant."

Page 190. "Mr. Murray reasonably observes Joliba seems readily convertible into Joli-ba, the latter syllable being merely an adjunct signifying river; this I was also given to understand."

This is an etymological error; the Joliba is not a compound word; if it were, it would be *Bahar Joli*, not Ba Joli or Joliba; thus do learned men, through a rage for criticism, and for want of a due knowledge of African languages, render confused, by fancied etymologies, that which is sufficiently clear and perspicuous.

Page 191. "The river of Darkulla, mentioned by Mr. Brown."

This is evidently an error; there probably is no such place or country as Darkulla; there is, however, an alluvial country, denominated *Bahar Kulla*, (vide map of Africa, in the new Supplement to the *Encyclopædia Britannica*, p. 88, lat. N. 8°, longitude East 20°.) I apprehend this Darkulla (when the nations of Europe shall be better acquainted with Africa) will be discovered to be a corruption of *Bahár Kulla*, or an unintelligible and an ungrammatical term. Diaar Kulla is grammatical, and implies a country full of houses; Darkulla is an ungrammatical and an incorrect term, and literally rendered into English signifies *many houses*. This being premised, we may reasonably suppose that Bahar Kulla is the proper term; which forms, as I have always understood, the junction of the Neel Elabeed with the Bahar Elabeed, called in the modern maps of Africa, Bahar Elabeade, and hence forming a continuity* of waters from Timbuctoo to Cairo.

191. In this geographical dissertation of Mr. Bowdich, the word Niger is still used, which is a name altogether unknown in Africa, and calculated to confuse the geographical inquirer. As this word is unintelligible to the natives of Africa, whether they be Arabs, Moors, or Negroes, ought it not to be altogether expunged from the Maps? E.

192. In the note in this page, Jackson's report of the source of the Neel Elabeed, and the source of the Senegal, is confirmed by the Jinnee Moors (see Jackson's *Appendix*, to his account of *Marocco*, enlarged edition, p. 311.) It is said that, thirty days from Timbuctoo they eat their prisoners. Does this allude to † Banbugr?

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* See my letter in the *Monthly Magazine*, for March, 1817, page 125.

† The qr in Banbuqr is the Arabic غ. Richardson, in his *Arabic Grammar*, renders this letter gh, which demonstrates that his knowledge

and has not this word been corrupted by Europeans into Banbarra, or Bambarra. See Mr. Bowdich's MS., No. 3, p. 486, (Bambuqr, who eat the flesh of men,) Jackson's translation.

193. The government of Jinnee appears to be Moorish, because Mulai (not Malai) Smaera, signifies, in the Arabic language, the Prince Smaera; the term does not belong to Negroes, but exclusively to Mohammedans. Mulai Bukari (not Malai Bacharroo, which is a Negro corruption of the word,) the race of Bukari, called Abeed Mulai Bukari, is renowned among the Negroes of Sudan; the Negroes of this race form the best troops of the emperor of Morocco's army, and the body-guard, consisting of 5,000 picked men, are exclusively of the Abeed Mulai, or Seedy Bukari; they are well-disciplined troops, and are the only soldiers that can effectually be put in hostile competition with the Berebbers of the Atlas Mountains.

Note, p. 194. Dapper's description of Africa is here quoted in confirmation of the decay of Timbuctoo, and Jackson is accused of extravagance; the latter I shall pass by, it being an assertion unsupported by any substantial testimony, but immediately afterwards is the following passage:

"The three last kings before Billa (*id est*, Billabahada,) were Osamana (*id est*, Osaman, Osamana being the feminine gender,) *Da Woolo*, and Abass. Mr. Jackson says, there was a king Woolo reigning in 1800; and a Moor who had come from Timbuctoo to Comassie ten years ago, (*viz.*, about 1807, or ten years before Mr. Bowdich was in Ashantee,) did not know king Woolo was dead, as he was reigning at the time he left Timbuctoo."

With regard to Dapper's assertion, it should be remembered that, if Timbuctoo was decaying in his time, that is about the period that Muley Ismäel ascended the throne of Morocco, *viz.*, in 1672, it revived very soon after, that is, before the close of the 17th century. This powerful and politic emperor of Morocco had the address to establish and to maintain a strong garrison at Timbuctoo; and, accordingly, during his long reign of 55 years, *viz.*

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of Arabic was only scholastic, no practical; it has no affinity whatever to gh. J. G. J.

from 1672 to 1727, Timbuctoo carried on a very extensive trade with Morocco, in gold dust, gum, sudan, ostrich feathers, ivory, &c.; and attabas, or cafilahs, or caravans, were going to and from Timbuctoo to Tafilett, Morocco, and Fas, throughout the year: and travelling was then as safe through the Sahara as it is now in the plains of Marocco, or in the roads in England; the only months during which the caravans did not travel were July and August, because the shume, or hot wind of the Desert, prevails during these two months. It is reported that Muley Ismäel was so rich in gold, that his kitchen utensils and the bolts of the gates of his palaces were of solid gold. Timbuctoo continued, with little diminution, to carry on a lucrative trade with Marocco during the reign of the emperor Muley Abdallah, son and successor of Ismäel, and also during the reign of * Seedy Mohammed ben Abdallah, who died about the year 1795, a sovereign universally regretted by his subjects, who was father to the reigning emperor, Muley Solimen ben Mohammed. If, therefore, the trade with Timbuctoo declined in Leo's time, (1570) it unquestionably revived in Ismäel's reign, and also during the reign of his son Abdallah, and of his grandson Mohammed. Since the decease of Mohammed, the trade has declined, because the present emperor's policy leads him to discourage commerce, and to encourage the agriculture and the manufactures of his country, so far as to supply the wants of his own country, and not farther, his political principle being to make his country and its produce sufficient for itself, and as independent as possible of foreign supplies.

Da Woolo is a reverential term, and is synonymous with Woolo, signifying king Woolo.

Park says, Mansong was king of Timbuctoo in 1796, and in 1805, implying thereby that he reigned from 1796 to 1805.

Isaaco says, Woolo was predecessor to Mansong, consequently, according to this, Tew Woolo was king before the year 1796. Mr. Bowdich's Moor left him king at Timbuctoo in 1807; there-

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* It should be observed, that an emperor, having the name of the Arabian prophet, is called Seedy; but having any other name, he is denominated Muley, or Mulai.

fore, if Mr. Park's testimony be admitted as correct, Woolo must have been predecessor, and successor to Mansong; otherwise Mr. Park was not correct in saying that Mansong was king of Timbuctoo, in 1796 and in 1805.

Adams says, Woolo was king of Timbuctoo in 1810, and was old and grey-headed. Riley's *Narrative* also confirms his age and grey hair; with regard to my testimony, that * Woolo was king of Timbuctoo in 1800, I had it from two Moorish merchants of veracity, who returned from Timbuctoo in 1800, after residing there fourteen years. They are both alive now, and reside at Fas; their names I would mention, were I not apprehensive that it might lead to a reprimand from the emperor, and create jealousy for having communicated intelligence respecting the interior of this country. I should not have entered into this detail, if the editor of the *Supplement to the Encyclopædia Britannica* (article *Africa*) had not asserted that I have committed an anachronism, in asserting that Woolo was king of Timbuctoo in 1800, thereby insinuating that Park was right and that I was wrong.

Page 195. The editor of Adam's *Narrative* is, I apprehend, incorrect in saying, that the name Fatima affords no proof that the queen, or the wife of Woolo, was a Mohammedan. Fatima is incontestably an Arabian proper name, and it would be considered presumption in a Negress, not converted to Mohammedanism, to assume the name of Fatima. She must, therefore, have been necessarily a Mooress, or a converted Negress; the name has nothing to do with a numeral, and, above all, not with the numeral five, for that is a number ominous of evil in Africa, and as such would never have been bestowed as a name on a beloved wife.

Page 196. Note of W. Hutchinson. "The four greatest monarchs known on the banks of the Quolla are Baharnoo, Santambool, Malisimid, and Malla, or Mallowa." Baharnoo should, as I apprehend, be written Ber Nah, *i. e.*, the country of Noah, the Patriarch; it is called in the maps Bernoo, and the whole passage is calculated greatly to confuse African geography; the information is unquestionably derived from Negro authority, and that not of the most authentic kind. Santambool is the Negro corruption of Stràmbool, which is the Arabic for Constantinople. Malisimiel is the Negro corruption of * Muley Ismäel. The first signifies the empire of Constantinople, the second signifies the empire of †Muley Ismäel, who was emperor of Marocco in the early part of the 18th century, and whose authority was acknowledged at Timbuctoo, where he maintained a strong garrison, and held the adjacent country in subjection. This being premised, one of these four great monarchies here alluded to, *viz.*, that of Santambool is not certainly on the Quolla, unless the Quolla be considered the same river with the Egyptian Neele, and that Egypt be considered a part of the empire of Santambool; then and then only can it be said that the empire of Santambool is situated on the Quolla.

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* See my Letter in the *Anti-Jacobin Review*, on the Interior of Africa. Jan. 1818, p. 453.

Page 198. "Two large lakes were described close to the northward of Houssa, one called Balahar Sudan, and the other Girrigi Maragasee."

The first of these names is a Negro corruption of the term ‡ *Bahar Sudan*, the other is a Negro name of another, if not of the same sea or lake; the situation of the Bahar Sudan is described by me in the Appendix to my account of Marocco, to be fifteen journeys east of Timbuctoo, and the Neel El Abeede passes through it. I have this information from no less than seven Moorish merchants of intelligence and veracity; the same is confirmed by Aly Bey, the Shereef Immhammed, Park, and Dr. Seitzen ¶; all these authorities must therefore fall to the ground, if Mr. Bowdich's report on *Negro Authority* is to overturn these testimonies, which has placed it three degrees of latitude north of the Neel El Abeede, or Neel Sudan, and in the Sahara *, *unconnected with any rivers*. I doubt if any but a very ignorant Pagan Negro (for the Mohammedan Negroes are more intelligent,) would have given the sea of Sudan this novel situation.

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* See the Appendix to Jackson's *Marocco*, chap. 13, p. 295, and Note, 296.

† Muley Ismäel was great grandfather of the reigning emperor of Marocco, Muley Soliman. He established his power in Sudan, and had a strong garrison at Timbuctoo, where his name is still mentioned with reverence.

‡ See Jackson's *Marocco*, enlarged edition, chap. 13th.

¶ For an elucidation of these opinions, see my Letter on the Interior of Africa, in the *European Magazine*, Feb. 1818, p. 113.

Page 200. The Quolla appears to be the Negro pronunciation of the Arabic name Kulla, *i.e.*, the Bahar Kulla, to which the Nile of Sudan is said to flow. Bahar Kulla is an Arabic word, signifying the sea altogether, or an alluvial country, the Neel of Sudan here joins the waters of a river that proceed from the Abyssinian Neel westward, and hence is formed the water communication between † Cairo and Timbuctoo.

Page 201. Quollaraba, or Kullaraba, signifies the Kulla forest as the Negroes express it. The Arabs call it Raba Kulla, *i. e.*, the Forest of Kulla; therefore, if any farther proof of the accuracy of this interpretation be necessary, it may be added that the position agrees exactly with Major Rennel's kingdom of Kulla, for which see the Major's map, in proceedings of the African Association, Vol. I. p. 209. Lat. N. 9°. Long. W. 10.

Page 203. The lake Fittri is a lake, the waters of which are said to be filtered through the earth, as the name implies; the Neel is here said to run under ground. The Moors have a tradition, that the waters of the flood rested here, and were absorbed or filtered through the earth, leaving only this large lake. I never understood this sea to be identified with the Bahar Heimed ‡, *i. e.*, the Hot or Warm Sea; the Hot Sea and the Filtered Sea are distinct waters, the former lays about mid-way, in a right line, between Lake Fittri and Lake Dwi. (See Laurie and Whittle's *Map of Africa*, published in 1813.) This is another inaccuracy of Mr. Hutchison, who appears indeed to have collected information from natives, without considering what title they had to credibility; another error is added to the note in p. 203 and 204, *viz.*, what he calls sweet beans are unquestionably dates, which have not the least affinity in taste, shape, growth, or quality, to beans. The Arabic name correctly converted into European letters is *timmer*, not tummer; the African Arabic word designating sweet-beans, is Elfoole el Hellue. The passage, signed W. Hutchison, here alluded to is this: " The Arabs eat black-rice, corn, and sweet-beans, called tummer."

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* See Mr. Bowdich's Map, in his *Account of a Mission to Ashantee.*

† See Appendix to Jackson's *Marocco*, enlarged edition, p. 313. See also my Letter to the Editor of the *Monthly Magazine*, for March 1817, p. 125.

‡ Heimed is an Arabic term signifying that degree of heat, which milk has when coming from the cow or goat.

Note, page 204. I do not know whence the *Quarterly Review* has derived its information, respecting the derivation of the word Misr, (a corruption of Massar); the word Massar is compounded of the two Arabic words, Mamother, and Sur of Walls, *i. e.*, Mother of Walls, as Bassora is compounded of the two Arabic words, Ba and Sora, Father of a Wall. Possibly some Arabic professor, versed in bibliographic lore, to favour a darling hypothesis has transmuted Massar into Misr, to strengthen the plausibility of the etymology of Misr from Misraem.

Note, page 205. *Bahar belama* is an Arabic word, importing it to be a country once covered with water, but now no longer so: in the note in this page I recognize the word Sooess to designate the Isthmus of Suez. The Bahar Malee and Sebaha Bahoori are Negro corruptions of the Arabic words *Bahar Elmalah* and *Sebah Baharet ;* the former does not apply particularly to the Mediterranean, but is a term applicable to any sea or ocean that is salt (as all seas and oceans assuredly are); the latter term signifies literally the seven seas, or waters; neither is this a term applicable to the Mediterranean, but to any sea supplied by seven rivers, as the Red Sea. These are, therefore, evidently other inaccuracies of Mr. Hutchison. I apprehend Mr. Hutchison's Arabic tutor at Ashantee was not an erudite scholar; the term, and the only term in Africa, applicable to the Mediterranean Sea, is the Bahar Segreer, (literally the Small Sea); and El Bahar Kabeer is the Atlantic Ocean, or literally, the Great Sea; this latter is figuratively called El Bahar Addolon, *i. e.*, the Unknown Sea, or, the Sea of Darkness.

Note, page 206. Is it possible that the author doubts that Wangara is east of Timbuctoo? it should seem that he did, as he quotes Mr. Hutchison as authority for making it to contain Kong, a mountainous district, many journeys south of the Nile of Sudan. Mr. Park's testimony is also called in support of this opinion, but they are both erroneous. Wangara is as well known in Africa to be east of Timbuctoo, as in England York is known to be north of London. Oongooroo is a barbarous Negro corruption of Wangara; therefore this note, if suffered to pass through the press unnoticed, would be calculated to confuse, not to elucidate, African Geography; neither can it be called, according to Mr. Horneman's orthography, Ungura, the name is وانڭاة, which cannot with accuracy be converted into any word but *Wangara*. Ungura, Oongooroo, *&c.*, are corruptions of the proper name, originating in an imperfect, and but an oral knowledge of the African Arabic.

Note, page 210. I apprehend the reason why Wassenah was not known at Ashantee by the traders is, because it was out of their trading tract. I have no doubt of the existence of Wassenah, or Massenah, and that it is a powerful country in the interior of Africa, (for where the names of African countries are recorded, we should not be particular about a letter or two, when we find so many orthographical variations are made by different authors); neither is there any reason, that I know of, to doubt Seedy Hamed's account of Wassenah in Riley's Narrative. It is not extraordinary that Wassenah, or Massenah should be unknown at Ashantee, if there were no commerce established between the two places. It is certain that the Africans neither seek, nor care for places, or countries, with which they have no trade or connexion.

It appears well deserving of observation, (for the purpose of rendering Arabic names intelligible to future travellers), that Mr. Bowdich has demonstrated, that what is called in our maps Banbarra, Gimbala, Sego, Berghoo, and Begarmee, being written in the African language with the guttural letter g̅rain, would be quite unintelligible if pronounced to an African as they are written in our letters; the nearest approximation to the Arabic words would be as follows, taking gr for the nearest similitude that our alphabet will give of the guttural letter g̅rain غ

1. Banbugri	بنبغ `	called in the maps	Bambarra.
2. Grimbala	غمبَلَ	——	Gimbala.
3. Shogru	شاغُ	——	Sego.
4. Bergru	برغوا	——	Berghoo.
5. Bagrarmee	باغرمر	——	Begarmee.

The African traveller should be precise in his attention to the sound of these words, otherwise he will be quite unintelligible to the Africans and to the Mohammedans.

Richardson, in his *Arabic Grammar*, is certainly incorrect, when he says the letter غ (grain) should be pronounced gh; no man acquainted *practically* with the Arabic language could be of this opinion, gh having no more resemblance to the sound of the letter غ grain, than g has to h; and every one going to Africa with this erroneous opinion of Richardson, will, undoubtedly, be unintelligible to the Africans.

Finally, the Arabic document, if I may be allowed to call it Arabic, facing page 128, of this interesting work, is a most miserable composition of Lingua Franca, or corrupt Spanish, of unintelligible jargon, abounding in words totally incomprehensible to the Africans, whether Negroes or Arabs; the language is worse, if possible, than the scrawl in which it is written; neither is it a correct translation of the English which precedes it. But purporting to be a letter issuing from the accredited servants of the King of the English, it is certainly a disgrace to the country from whence it issues, and a rare specimen of our knowledge of African languages.

ART. XV. *Chinese Cruelty.*

[The following translation is taken from a periodical publication, issued quarterly from the Missionary press in Malacca, called the *Gleaner*.]

CHINESE justice has been a topic of high eulogium; and there is often a reasonable mode of talking, and a plausibility about it, which is now and then very imposing; but the want of truth and reality in these hypocritical and specious pretences, is shockingly great. In confirmation of these remarks, I beg to submit the following translation of an original document.

" PEKING GAZETTE, AUGUST 9, 1817.

" Chow, the Yu-she (or Censor) of Ho-nan, kneels to report, with profound respect, in the hearing of his Majesty, the following circumstances, and to pray for his sacred instructions.

" The clear and explicit statement of punishments, is a means of instruction to the people ; the infliction of punishments, is a case of unwilling necessity. For all courts there are fixed regulations to rule their conduct by, when cases do occur that require punishments to be inflicted in questioning. Magistrates are not, by law, permitted to exercise cruelties at their own discretion.

" But of late, district Magistrates, actuated by a desire to be rewarded for their activity, have felt an ardent enthusiasm to inflict torture. And though it has been repeatedly prohibited by Imperial Edicts, which they profess openly to conform to, yet they really and secretly violate them.

" Whenever they apprehend persons of suspicious appearances, or those charged with great crimes, such as murder, or robbery, the Magistrates begin by endeavouring to SEDUCE the prisoners to confess, and by FORCING them to do so. On every occasion they torture by pulling, or twisting the ears, (the torturer having previously rendered his fingers rough by a powder) and cause them to kneel a long while upon chains. They next employ what they call, the Beauty's Bar *, the Parrot's Beam †, the Refining Furnace ‡, and other implements, expressed by other terms which they make use

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* A torture said to be invented by a judge's wife, and hence the name. The breast, small of the back, and legs bent up, are fastened to three cross bars, which causes the person to kneel in great pain.

† The prisoner is raised from the ground by strings round the fingers and thumbs, suspended from a supple transverse beam.

‡ Fire is applied to the body.

of. If these do not force confession, they double the cruelties exercised, till the criminal dies, (faints) and is restored to life again, several times in a day. The prisoner, unable to sustain these cruelties, is compelled to write down or sign a confession (of what he is falsely charged with) and the case any how is made out, placed on record, and, with a degree of self-glorying, is reported to your Majesty. The imperial will is obtained, requiring the person to be delivered over to the Board of Punishments for further trial.

" After repeated examinations, and undergoing various tortures, the charges brought against many persons are seen to be entirely unfounded.

" As for example, in the case of the now-degraded Taeu-tae, who tried Lew-te-woo, and of the Che-chow, who tried Pĭh-keu-king. These mandarins inflicted the most cruel tortures, in a hundred different forms, and forced a confession. Lew-te-woo, from being a strong robust man, just survived—life was all that was spared. The other, being a weak man, lost his life; he died as soon as he had reached the Board at Peking. The snow-white innocence of these two men was afterwards demonstrated by the Board of Punishments.

" The cruelties exercised by the local magistrates, in examining by torture, throughout every district of Chĭh-le, cannot be described; and the various police runners, seeing the anxiety of their superiors to obtain notice and promotion, begin to lay plans to enrich themselves. In criminal cases, as murder and robbery; in debts and affrays, they endeavour to involve those who appear to have the slightest connexion. The wind being raised, they blow the spark into a flame, and seize a great many people, that they may obtain bribes from those people, in order to purchase their liberation. Those who have nothing to pay, are unjustly confined, or sometimes tortured, before being carried to a magistrate. In some instances, after undergoing repeated examinations in presence of the magistrate, they are committed to the custody of people attached to the court, where they are fettered in various ways, so that it is impossible to move a single inch; and without paying a large bribe, they cannot obtain bail. Their oppressions are daily accumulated to such a degree and for so long a time, that at last death is the consequence.

"Since there is at this period particular occasion to seize banditti, if there be suspicious appearances, as the age or physiognomy corresponding to some offender described; it is, doubtless, proper to institute a strict inquiry.

"But it is a common and constant occurrence, that respecting persons not the least implicated, who are known to possess property, and to be of a timid disposition, pretences are made by the police to threaten and alarm them. If it be not affirmed, that they belong to the Pĭh-leën-keaou, (a proscribed sect,) it is said that they are a remnant of the rebels, and they are forthwith clandestinely seized, fettered, and most liberally ill-used, and insulted. The simple country people become frightened and give up their property to obtain liberation, and think themselves very happy in having escaped so.

"I have heard that in several provinces, Chĭh-le, Shan-tung, and Ho-nan, these practices have been followed ever since the rebellion; and wealth has been acquired in this way by many of the police officers. How can it be that the local magistrates do not know it; or is it, that they purposely connive at these tyrannical proceedings?

"I lay this statement, with much respect, before your Majesty, and pray that measures may be taken to prevent these evils. Whether my obscure notions be right or not, I submit with reve-

IMPERIAL REPLY.

"It is recorded."

I think you will agree with me, Mr. Editor, that the above is a very lamentable state of society. When my Moonshe read this paper, he said, "I knew this was the state of things in Canton, but I never thought it was so in the other provinces; this is what drives people to rebellion; in nine cases out of ten, it is the government causes rebellions." There is, I fear, much truth in the latter part of the old gentleman's remark.

AMICUS.

Art. XVI. *A Note respecting the Operations and Discoveries of* Belzoni *in Nubia. By* Curtin, *an Irish youth who accompanied him.*

As soon as Belzoni had safely deposited the Memnon's head at Alexandria and the statues and other antiquities, discovered at Thebes, with Mr. Salt at Cairo, he set out on his journey to Nubia, with the view of opening the temple of Ipsambul, or Absimbul, situated near the second cataract of the Nile; the account of which, and of its gigantic statues, as mentioned by Mr. Bankes, had excited no ordinary degree of curiosity in the mind of this enterprising traveller.

We were at Philæ on the 5th of June, 1817. The day before we kept in honour of his Majesty's birth-day, for the first time it had ever been kept there. Mr. Belzoni had an inscription cut on this occasion in the upper part of the portico; it is as follows:

> " British colours have been hoisted here, and a royal salute fired, June 4th, 1817, by J. Belzoni and Captain Irby, Mr. Beechy and Capt. Mangles."

Mr. Belzoni and the party hired a boat at this place, and left it for Absimbul; and, passing the island of Kalaptshi (for they did not call there, as the rhamadan was then near at hand,) they made no stay any where, until they arrived at Abusimbul. On their arrival there Mr. Belzoni went to call on the cashief of the place, who was very happy to see Mr. Belzoni, as he expected some present; and Mr. B. had promised him one, on condition that he would not let any one touch the temple, nor take the wood away that he put there to keep the sand taken out from falling in again, which he (the cashief,) did, and kept his word very honourably. For there were some Frenchmen there, and he would not let them have any thing to do with it; so Mr. Belzoni kept his word also, and made him a present of a fowling-piece, and some soap and coffee, things that are very acceptable in that country. On so doing, he asked the cashief, if he could have some men to work in the morning; he said, Yes, by all means; and asked him how many he would want. Mr. B. said, About twenty men. He then left us, and returned to the boat.

The next morning they prepared to work, and Mr. Belzoni made them begin in the same place in which they had formerly left off; but though he succeeded in getting them to work for a few days, until the Rhamadan came on, they then would not work more than two or three hours in the day, and that for a few days only. Mr. B. was determined not to suffer this imposition any longer, for as soon as the *duha*, or twelve o'clock came, they all went away after a leader, who put a white handerchief on the top of a pole, and cried out, "He who is of the faith of Mahomet follow me," and they all immediately did so, and continued for several days so to do; and yet their pay was very great, for they had two piastres a day. The last day Mr. B. told them, that they need not come to-morrow; at which they seemed much pleased, thinking that they were to have the same job the ensuing year. They then went away.

Now, Mr. Belzoni called Mr. Beechy, Capt. Irby, and Capt. Mangles, and asked them if they were willing to work; telling them that he found it impossible to do any thing with the inhabitants, that the Rhamadan was one of the worst times they could have; as the Mahommedan faith prohibited even water from sun-rise t sun-set; and he said also, that they were four, besides the interpreter, and the soldier who was an Italian, and had made himself a Turk, and was very useful to travellers. There was also the cook, who was equally useful, for he was cook, and distilled aqua-vitæ, and made candles; in short, I never met with a man that was so useful to a traveller, for he spoke Italian and English; he is a Copt, and his name is *Girgis*. They all consented to what Mr. Belzoni proposed, and the next morning they went to work, and found that what they had done in four hours, was more than the sixty Barabers had done in one day.

When the Barabers heard what they were doing, they gave orders that, on pain of death, no one should sell any thing to the caffres, or *nusononys* (infidels.) This was a very great check to their proceedings; but Mr. Belzoni had bought some *dourah* at Essouan, for the purpose of making presents to the Nubians, and had also some dates, which he ordered to be boiled, and the dates to be steeped in water, and poured on the dourah. This was their diet for eighteen days, after which time he found the door (entrance of the temple ?) There had been some disagreement between Mr. B. and Capt. Mangles, on account of taking a different line to get at the door; and Mr. B. would not consent to alter the plans, but followed in the same way he had begun, and, to their great astonishment, soon found he was right, for, in the evening of the 14th day, he discovered the frieze of the door, and on the 16th day they entered, and found it so hot within that they were obliged to retire. Mr. Belzoni took the plan and section of the temple, and then left the place, giving the temple in charge to the cashief, and telling him that he would have some more presents from the consul, and not to let the men throw in the sand again. He promised it should be taken care of, and hoped that the Consul would not forget him. Mr. Belzoni took four statues that he found in the temple, *&c.* They then returned to Philæ, and afterwards to Thebes, where Belzoni again set about the excavation, during which he found the alabaster sacophagus. I was not with my master at Abissimbul, but he told me all that had happened when he came down to Philæ, where I remained with Mrs. Belzoni, who is a native of Bristol, about twenty-eight years of age.

Art. XVII. *Some of the Questions proposed to* George Bidder, *the Devonshire Boy.*

1. Reduce 1,000,000 farthings to pounds, &c.

Ans. (in 3 seconds) 1041*l.* 13*s.* 4*d.*

2. Reduce 19*l.* 19*s.* 10¾*d.* to farthings.

Ans. (in about 3 seconds) 19,195 qrs.

3. The circumference of the earth being 360 degrees, each degree 69½ miles, what is the number of yards.

Ans. (in 5 seconds) 44,035,200 yards.

4. If the step of a horse be 2¾ feet, and that of a man 2½ feet, how many steps of a man are equal to 40 of a horse.

Ans. (in 7 seconds) 44 steps.

5. If the step of a horse be 2¾ feet, how many steps does he take in going a mile.

Ans. (in 10 seconds) 1,920 steps.

6. If the distance betwixt the sun and the earth be 96,000,000 of miles, now long would a body moving at the rate of 8½ miles per minute be in moving that distance, allowing 365 days to a year.

Ans. 21 years 178 days 3 hours $17\frac{11}{17}$ minutes. (The denominations in which he was desired to give the answers in the short time of 25 seconds.)

7. How many palisades will surround a square piece of ground, whose side is 150 yards, at 10 inches asunder.

Ans. (in 12 seconds) 2,160.

8. Multiply 4444 by 4444.

Ans. (time not observed) 19,749,136.

9. What is the cube root of 51,230,158,344.

Ans. (time not observed) 3714.

10. The difference of two numbers is five, and the difference of their cubes 1685, what then are the two numbers.

Ans. (time not observed) 8 and 13.

11. If the sum of 2 numbers be 11, and the sum of their 5th powers 17,831, what are the numbers.

Ans. (quickly) 4 and 7.

12. Find two whole numbers having 77 for the difference of their squares.

Ans. (very quickly) 38 and 39; but on being told that another answer might be given, was some time in discovering 2 and 9.

13. The sum of 3 numbers is 32, the sum of their squares 350, and the sum of their cubes 3926, what are the three numbers.

Ans. 9, 10, and 13; the time very short indeed for a cubic equation, perhaps about 25 seconds.

14. What is the cube root of 131,872,229.

Ans. 509, (time very short).

15. If the base of a triangle be 5,240 yards, and perpendicular 1956, what is the content in acres.

Ans. $1058\frac{100}{121}$ acres; to this he gave a wrong answer.

16. If the diameter of a globe that weighs 24 pounds be 8 inches, what is the diameter of another globe that weighs 72 lbs.

Ans. 11.538 inches, nearly: this he answered wrong, but complained of being interrupted.

17. Divide 176 into two such parts that their product may be 7663.

Ans. (very quickly) 79 and 97.

18. Divide the same number into two parts whose product may be only half of what it was before, viz. 3831½.

This he said "I cannot answer, it goes too far into fractions:" his idea of a surd!—True answers being $88+\sqrt{3913\frac{1}{2}}$ and $88-\sqrt{3913\frac{1}{2}}$.

19. At a certain election 1296 persons voted, and the successful candidate had a majority of 120—how many voted for each.

Ans. (instantly) 708 and 588.

20. Two travellers set out at the same time from London and York, distant 197 miles, the one travels 14 miles a day, the other 16, how many days will they travel before they meet.

Ans. (instantly) 6 days $13\frac{3}{5}$ hours.

21. A person left 560*l.* between his son and daughter; for every half-crown the son had, the daughter was to have a shilling—what was the share of each.

Ans. (in 5 seconds) 400*l.* and 160*l.*

22. What two numbers are those whose sum is 20, and their product 36.

Ans. (instantly) 2 and 18.

23. The difference of two numbers is 8, and the difference of their 4th powers 14,560, what are the numbers.

Ans. 3 and 11, (in 65 seconds, a short time for a cubic equation.)

24. In how many different ways is it possible to pay 20*l.* in half-guineas and half-crowns only.

Ans. (in 30 seconds) 7 ways.

25. A person wishing to enclose a piece of ground with palisades, found that if he set them a foot apart, he would want 150 more, but if he set them a yard asunder, he would then have 70 to spare—what was the number of palisades.

Ans. 180 (time not observed).

26. Divide 100 guineas among 7 men, and give each man a quarter of a guinea more than another.

Ans. The least share 14*l.* 14*s.* 3*d.* (This stopt him some time, perhaps 4 minutes).

27. Divide 23*l.* 10*s.* 10*d.* among 5 men, 7 women, and 6 boys, and give each man double a woman's share, and each woman double a boy's share.

Ans. A boy 11*s.* 9¼*d.*—woman 1*l.* 3*s.* 6½*d.*—man 2*l.* 7*s.* 1*d.*

ART. XVIII. *Dr.* Wilson Philip's *Reply to some Observations relating to his Inquiry into the Laws of the Vital Functions in the last Number of the Quarterly Journal, in a Letter addressed to* W. T. Brande, *Esq.*

Worcester, May 20, 1819.

SIR,

As you have in the last number of the *Quarterly Journal*, which did not fall into my hands until the day before yesterday, inserted a paper relating to some experiments of mine, in which there appears to me to be several mistatements, you will, I am persuaded, do me the justice to insert the following observations in the next number of that work. Why you should say that in the appendix to the second edition of my *Inquiry into the Laws of the Vital Functions*, I have made an attack on the President and Council of the Royal Society, I am wholly at a loss to understand; for I cannot conceive, Sir, that you are actuated by a wish to prepossess the feelings of the reader against me, before you make an appeal to his judgment; nor can I, on the other hand, see any thing in my treatise, which can possibly be construed into an attack on the President and Council of the Royal Society, for whom I have ever felt and expressed the greatest respect; and whose conduct towards me has been calculated to excite no sentiments but those of esteem and gratitude, as I have hinted in more than one passage of the appendix to which you allude.

I had found, from various circumstances there stated, that an implied charge had been brought against me in the Royal Society. I only requested that the President and Council would call on the author of that charge, either to substantiate what he had advanced, or acknowledge his error. A regard for my character required this step, and any person who will take the trouble to read the appendix in question, will admit that I did not take it hastily.

Permit me, in the first place, to mention two inaccuracies, which it appears, from the observations in the *Quarterly Journal*, the clerk of the Royal Society must have committed in the account he sent to me of the experiment supposed to invalidate the result of mine. In that Journal it is said, " Dr. Philip in his account of ' the latter experiment has left a blank, where the name of the ' nerves should have been inserted; whereas the words *par* ' *vagum*, were written as plain as any other part of the paper." In the copy sent me *par vagum* is not mentioned, but a blank left, as any gentleman may satisfy himself by requesting a friend here to to inspect it. Mr. Andrew Knight, a distinguished member of the Royal Society, has seen it. In the *Quarterly Journal* it is said, " The manuscript dissertation of Dr. Philip was then re- ' turned to the clerk of the Society, and a minute made during the time of the experiments *was accidentally left in it*." In the clerk's account it is stated, " The following is a copy of a paper " written in a different hand, and *pinned in page* 13, *over part of* " *the account of experiment* 3."

Of the experiment, an account of which was either accidentally left in, or pinned to the corresponding experiment in my paper, the observations in the *Quarterly Journal* give the following account. " When the paper was read before the Society, there were " many members who thought it was right that one of the experi- " ments should be repeated. Three of the members of this " Society undertook this task, one conducting the galvanic part, " another the anatomical part, and the third, who was not made " acquainted which was the galvanised rabbit, was called in after " the experiment was over, to decide upon the stomach in which " the food was most acted upon. That the experiment might be " repeated with the greater accuracy, the paper was put into " these gentlemen's hands, who implicitly followed the directions " contained in it." This is what I have denied, because, for example, in my experiment a continued stream of galvanism was maintained, while in that here alluded to, only occasional contacts were made between a wire connected with the other end of the battery and the tinfoil in the neck. But it is stated in the *Quarterly Journal* that, "Dr. Philip says that in his experiment there "were muscular contractions produced by the galvanic influence, "which proves that he employed it not in a continued stream, "but by occasional contacts, as in the experiment made by the "members of the Royal Society." The gentlemen who make this statement must, indeed, be unacquainted with the effects of galvanism on the living animal body, when they suppose that a continued stream of galvanism of a certain power, applied as in my experiments, does not occasion a constant repetition of contractions in the neighbouring muscles. Not only the continued stream, but the requisite power of galvanism, was wanting in their experiment; because it requires a much greater power to occasion repeated contractions of the muscles by a continued stream, than by occasional contacts of the metals. The above gentlemen, therefore, so far from repeating the experiment in the way in which I made it, here deviated from it in so important a circumstance, that had their experiment in other respects resembled mine, this deviation alone must necessarily have occasioned a different result.

The observations in the *Quarterly Journal* thus proceed: "These "gentlemen were quite competent to the task, and each confined "himself to his own department; the third, who was employed "to examine the contents of the stomachs, after an accurate in- "spection, was unable to detect the slightest difference between "them. This result was stated to the President, to whom it was "also explained, that the rabbit, which is a species of ruminant, "does not digest its food till it has gone through a previous pro- "cess of maceration, and is therefore not so well fitted for such "experiments as animals that live on animal food." I have, with the assistance of Dr. Hastings and Mr. Sheppard, Physician and Surgeon to the Worcester Infirmary, examined, by killing the animal at various periods of digestion, the stomach of about a hundred and thirty rabbits, and they will attest the accuracy of what I say, when I declare that as far as we could judge from this extensive set of experiments, the results of which are stated at length in my *Inquiry*, the information thus given to the President of the Royal Society is incorrect. The rabbit is, in no sense of the word, a species of ruminant*.

In stating the result of their experiment, the above gentlemen observe, " On examining the stomach of the animal which had
" been subjected to the influence of the battery, it was found
" much distended with food. The parsley was principally in the
" cardiac portion. Near the œsophagus it appeared to have
" undergone no alteration, and below this it was mixed with other
" food in the stomach, so that no accurate observation could be
" made on it." In this experiment the *par vagum, it is said, had been divided in the neck*, and the animals had survived its division five hours, having ate as much parsley as they chose immediately before the operation, and after having fasted for seventeen hours I may here, in the first place, observe, that the gentlemen, in this part of their account, again shew how little they are acquainted with the subject in discussion. In the stomach of the rabbit the old and new food are never mixed†. In the healthy state of the stomach, the old and new food may, indeed, to a superficial view, appear to be mixed, for a reason pointed out in the 143d page of my *Inquiry* ; but the appearance which leads to this misconception is never observed under the circumstances of the above experiment, which I have many times witnessed. I subjoin the following declaration of Dr. Hastings :

" I hereby declare, that I have more than twenty times had occasion to perform the experiment of dividing the *par vagum* in the neck of the rabbit, when it had been allowed to eat parsley after a fast of many hours, and examined the contents of the stomach, the animal having been allowed to live for five or more hours after the operation, and I never found them in the state described in the *Quarterly Journal*, nor in any other state, but that described in the 154th page of Dr. Philips's *Inquiry into the Laws of the Vital Functions.*

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* It would have been candid in the gentlemen to have stated here, that an account of this experiment on a carnivorous animal, the dog, performed with the same result in the presence of several medical gentlemen, is given in my *Inquiry*.

† See the 142 page of the second edition of my *Inquiry*.

(Signed) "CHARLES HASTINGS.
Physician to the Worcester Infirmary."

My opponents in the *Quarterly Journal* forget to state, that in the most conclusive galvanic experiment on rabbits related in my treatise, the galvanism was applied for *sixteen hours. They did not allow themselves time to apply it even as long as in that, in which its effect from the short time of its application, six hours, was acknowledged to be imperfect.* The galvanised animal was never voluntarily killed by me. On the contrary, its life was always prolonged as much as possible. The galvanism, we have seen above, was neither applied in the same way, nor of the same power, as in my experiments. With what propriety, then, to say nothing of less important deviations, can these gentlemen, even according to their own account, maintain that they *implicitly followed the directions given in my paper?*

It is observed in my appendix, that no notice is taken of the symptoms which follow the division of the *par vagum* in the account of their experiment. In that they now publish, indeed, they state that dyspnœa occurred*; but still omit to mention the ineffectual attempts to vomit, which as constantly follow the division of the *par vagum*, as the dyspnœa does.

For what purpose the experiment, marked experiment II, in the *Quarterly Journal*, is detailed, I know not; as in all my experiments the nerves were divided in the neck, where, it has long been known to physiologists, their division destroys the power of the stomach.

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* They observe in a note—"In this experiment the respiration was "affected as usual after the division of the eighth pair of nerves, and it was not "observed that the dyspnœa was at all relieved by the galvanic influence." In reply to this I can only observe, that Dr. Hastings, Mr. Sheppard, myself, and several others, have very frequently witnessed the application of galvanism in the dyspnœa occasioned by dividing the *par vagum*, and never saw it fail to relieve this symptom, when it was applied of the proper strength. It is remarkable that so striking a difference of result, should not have been mentioned in the first account of their experiment.

I am asked, of what the animal died, in six hours, in my experiment quoted in the above Journal, if not of dyspnœa. The reader will find this question answered in the account of experiment 71 of my *Inquiry**.

In the latter part of the observations in the *Quarterly Journal* the authors allude to what they term "The morbid sensibility" of many of the members of the Royal Society, to some of my experiments which were made on living animals; but this sensibility can neither be termed morbid nor unreasonable, if, as I was informed, reports were industriously circulated, that these experiments were not only useless, but that from an erroneous choice of the animal on which they were made, it was impossible they should have been otherwise.

I have now stated the reasons which I believe entitle me to say, that the report of the three gentlemen in the *Quarterly Journal* leaves the statement, in my appendix, exactly where they found it; and indicates a degree of information which but ill accords with the confident style in which they write.

I cannot conclude without adverting to the circumstance of these gentlemen still persisting to conceal their names. This is seldom done on such occasions without a strong motive. I hope theirs is not such as the line of conduct they have for several years pursued, cannot fail to suggest. That three members of so respectable a Society, forgetful of better feelings, the boast of men of science, should combine to depreciate the exertions of an individual, is what I shall be very slow to believe.

I have the honour to be,
Sir,
Your very obedient humble servant,
A. P. W. PHILIP.

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* When I refer to my *Inquiry*, the number of the page or experiment is always that of the second edition.

ART. XIX. *Proceedings of the Royal Institution.*

DURING the season which has just terminated, four courses of lectures have been delivered in the amphitheatre of the Royal Institution, namely,

1. On the Principles of Experimental Chemistry, by W. T. Brande, Sec. R. S. and Prof. Chem. R. I.
2. On the Steam Engine, and its various improvements and applications, by J. Millington, Prof. Mech. R. I.
3. On Agricultural Implements and Processes, by ditto.
4. On Vegetable Chemistry, by Mr. Brande.

Two Courses of Experimental Demonstrations in Chemistry, have also been delivered by Mr. Brande, in the Laboratory of this Institution; these will recommence, as usual, early in the ensuing month of October, and will be continued during the season, which terminates in June.

The Visitors have made the following Annual Report on the State of the Royal Institution.

"The visitors have this year a most pleasing task allotted to them, in communicating to the members and well-wishers of the Royal Institution, a more prosperous state of their finances than could have been so soon expected. The income of the last year has exceeded the expenditure by £688. 11*s.* 11*d.*, the income being £3,491. 3*s.* 4*d.*, and the expenses only £2,802. 11*s.* 5*d.* The debts were reduced from £2,131. 11*s.* 3*d.*, to £1,667. 10*s.*, and there was a balance in hand of £179. 7*s.* 8*d.*

"They have the additional satisfaction of stating that the present prospect is still brighter.—By the contributions of new members since this account was made up, great progress has been made towards the reduction of the debt; and there is every reason to expect that there will be an opportunity before the conclusion of the present year of entirely discharging it, by applying, according to the intention of John Fuller, of Rose Hill, Sussex, Esq., his liberal donation of one thousand pounds, mentioned in the last year's Report.

"The next object will be the establishment of a permanent fund, for which purpose it is hoped that zeal and activity will not be wanting in supporting the exertions of the managers, still further to improve their finances, by recommending new members, by promoting benefactions and bequests, and by pursuing such other measures as are likely to be beneficial to so useful an Institution.

"They have likewise to report a donation of upwards of two hundred volumes of valuable books from the collection of the late Mrs. Sarah Sophia Banks, the sister of Sir Joseph Banks, bequeathed by her to Lady Banks, and presented by her Ladyship to the Royal Institution; and in consequence of an augmentation of the number of patrons of the library, and the contributions of new members, the funds appropriated to it are in an increasing state of prosperity; and it is to be hoped that new Patrons will come forward, as well as new Members, to contribute to the further enlargement of this valuable library.

"They have the satisfaction on concluding their report of stating, that all the premises belonging to the Royal Institution are in good repair.

Stafford.
George Aust.
Richard Horsman Solly.
Edward Codrington.
Henry Thomas Colebrooke.
John Fuller.
William Thornton."

The following Books have been presented to the Library of the Royal Institution, from January 1818, *to May* 1819, *inclusive.*

	DONORS.
Cases of Diseased Bladder, *&c.*, 4to. ..	W. Wadd, Esq. Surgeon Extraordinary to the Prince Regent.
An Argument for construing largely the right of an Appellee of Murder to insist on Trial by Battle; and also for abolishing Appeals, 8vo.	E. A. Kendall, Esq. F.A.S.

The first Centenary of Tables of complete Decimal Quotients	H. Goodwyn, Esq. M.R.I.
Sketches of Curvilinear Hothouses, 4to.	Mr. J. C. Loudon.
La Scava; or some Account of an Excavation of a Roman Town in Champagne; with a Journey to the Simplon, 8vo.	The Author.
The 35th Volume of the Transactions of the Society for the Encouragement of Arts, *&c.* 8vo.	The Society.
A Map of Egypt, on two sheets	Lt. Col. W. M. Leake, F.R.S. M.R.I., *&c.*
Observations on some important Points in the Practice of Military Surgery, 8vo.	Mr. John Hennen.
Morrison's Chinese Dictionary, 4to.	Directors of the East India Company.
Dialogues and Sentences in the Chinese Languages	
Observations on the Ophthalmic Cases of the Army	John Vetch, M.D.
The Literary Character illustrated	J. D'Israeli, Esq.
A Memoir of the Life of the Rev. W. Gregor, M.A.	Dr. Paris, M.R.I. & F.L.S.
Sir George Baker's Medical Tracts	Sir Fred. Baker, M.R.I.
On Import of Colonial Corn	H. T. Colebrooke, Esq. M.R.I.
L. J. Thenard's Principles of Chemical Analysis	Mr. Arnold Merrick.
Essai sur les Médailles antiques des Iles de Cephalonie et d' Ithaque	Lt. Col. C. P. De Bosset.
Considerations respecting Cambridge and its Botanical Professorship	Sir J. E. Smith, P.L.S., *&c.*
Considerations on the Colonization of the British Territories in Southern Africa	P. Colquhoun, Esq. M.R.I
Transactions of the Royal Geological Society of Cornwall	Dr. A. Paris, M.R.I. F.L.S.

The Hours; a Poem, by H. Hudson, Esq.	William Holmes, Esq.
Panthea; a Tragedy, by W. Benett, Esq.	
Constantine and Eugene; a Political Dialogue, 12mo.	The Author.
Strictures on the Uses and Defects of Parish Registers	Dr. G. Man. Burrows, F.L.S.
Episcopacy considered with reference to the modern popular Societies	The Author.
On the Safety Lamp for Coal Miners, 8vo.	Sir H. Davy, Bart.
Journals of the Academy of Natural Sciences of Philadelphia	The Academy.
Ittiolitologia Veronese, 2 vols. folio	A. B. Vallé, Esq. M.R.I.
Fœdera, vol. 2, part 1. folio	Commissioners of the Public Records.
Placita de Quo Warranto temporibus Edw. I. II. III., folio	
Rotuli Hundredorum temp. Hen. III. and Edw. 1, vol. 2, folio	
Transactions of the Horticultural Society, vol. 2, part 7, and vol. 3, part 1.	The Society.
Remarks on Burns and Scalds	Mr. Nodes Dickinson.
Observations Introductory to a Work on English Etymology	John Thomson, Esq.
Essays on the proximate Mechanical Causes of the general Phenomena of the Universe	Sir Richard Phillips.
Lt. Gen. Thornton's Speech in the House of Commons, 7th May, 1818	Lt. Gen. Thornton, M.R.I.
Studies of the Historic Muse, 4to.	The Author.
Letters of Yorick in favour of the Established Church	
La Sainte Bible, par les Pasteurs de Geneve, 8vo.	Rev. Dr. Abauzit.
Sermon pour la Solemnité du Jeune, 19 April, 1793	

On the Mimoses; a Descriptive and Practical Essay, 8vo.	Dr. Marshall Hall.
An English, Hindoo, and Mahomedan Almanack, for 1784	Wm. Cowper, Esq.
The European Magazine, for 1818	Mr. Asperne, the Publisher
The Repository of Arts, *&c.*, for 1818,	Mr. Ackermann, the Publisher.
Philosophical Transactions, for 1818, part I.	The Royal Society.
Tracts relative to the New View of Society, 8vo.	Mr. Robert Owen.
Enchiridion Romæ: or Remarks on the Buildings, *&c.*, of Rome, 12mo.	The Rev. Step. Weston, F.R.S., *&c.*
Elements of Medical Logic, 8vo.	Sir Gilbert Blane, Bart. F.R.S., *&c.*
Le Correspondent, ou Collection de Letters d'Ecrivans célébres de France, d'Angleterre, et autres pays de l'Europe, sur la Morale, la Politique, et la Litterature, 5 tom. 8vo.	Le Chevalier De Sade.
Augusteum: ou Description des Monumens antiques à Dresde, vol. 3, folio,	Sam. Solly, Esq. M.R.I.
Transactions of the Horticultural Society, vol. 3, part 2.	The Society.
Two hundred volumes of valuable books, part of the library of the late Mrs. Banks,	Lady Banks.
The Youth's Theological Dictionary, 12mo	Mr. E. Dowson.
Views in Sussex, drawn by Turner, engraved by Cooke	John Fuller, Esq. M.R.I.
Dr. Morton's Table of Alphabets	The Rt. Hon. J. Trevor.
Descrizione dell' Etna, 8vo	Abate Francesco Ferrara.
Astronomical Observations made at Greenwich, 1803 to 1816, folio	The Royal Society.
Philosophical Transactions, 1818, part II.	
Memoirs of the American Academy, vol. 4. part I.	The Academy.

A Defence of the Church and Universities of England	Sir J.E. Smith, P.L.S., *&c.*
Scripture compared with itself, in proof of the Doctrine of the Trinity	John Vaillant, Esq.
A Manual of Chemistry, 8vo.	W. T. Brande, Esq. Pr. of Chem. in R.I. *&c.* *&c.*
The Commemoration of Handel, and other Poems, 8vo.	John Ring, Esq.
Remarks on Captain Ross's Voyage of Discovery	Capt. Ed. Sabine, R.A.
Elements de Géométrie a trois Dimensions, 8vo.	M. Hachette, Professeur del'Ecole Polytechnique.
Second Supplément de la Géométrie Descriptive, 4to.	
Exposure of the Fallacies contained in the Letter to the Right Hon. Robert Peel, on Paper Currency, 8vo.	Cha. Wye Williams, Esq.
On the Relation of Corn and Currency.	The Author.
The 36th Volume of the Transactions of the Society for the Encouragement of Arts, *&c*	The Society.
Report of the Committee on the Forgery of Bank Notes	
The Edinburgh Philosophical Journal, No. I.	The Publishers.
An Essay on the Forces which circulate the Blood, 12mo.	Chas. Bell, Esq. F.R.S.E.
Proceedings in Parga and the Ionian Islands, 8vo.	Lt.-Col. C. P. De Bosset.
The Life of Sir Thomas Bernard, Bart.	The Rev. J. Baker, M.R.I.
A Critical Examination of the First Principles of Geology	G. B. Greenough, Esq P. of Geol. Soc.
M. Dupin's Excursions to the Ports of England, with a Description of the Breakwater at Plymouth, and of the Caledonian Canal, with Notes by the Translator	Capt. Monke, R.N.

A Philosophical and Practical Inquiry into the Nature and Construction of Timber .... Mr. John Lingard.

Several additions have been made, during the last year, to the Mineral and Geological Collection, and a donation for the purchase of Minerals of £10, by John Fuller, Esq.

The following **Members** *have been elected into the Royal Institution, from January* 1818, *to May* 1819, *inclusive.*

John Ware, Esq.
John Naylor, Esq.
James South, Esq.
Timothy Bramah, Esq.
Michael Shepley, Esq.
Vice-Admiral Sir Thomas Williams, K.C.B.
The Hon. Henry Verney.
George Watson Taylor, Esq. M.P.
Henry Peckitt, Esq.
Viscount Gage.
Lord John Campbell, M.P.
Robert Holden, Esq.
Robert Farquhar, Esq.
Colonel Leake.
Alexander Russell, Esq.
John G. Campbell, Esq.
Rev. James Baker, Chancellor of the Diocese of Durham.
Edward Bilke, Esq.
Sir Wm. Champion de Crespigny, Bart. M.P.
John Nonnen, Esq.
John Nicholl, Esq.
Henry Hallam, Esq.
Captain Wm. Maude, R.N.
Edward Solly, Esq.
Edward Cook, Esq.

Right Hon. Sir Wm. Scott, Knt., Judge of the High Court of Admiralty.
The Hon. Francis Ward Primrose, M.P.
Charles Nicholas Pallmor, Esq.
Thomas Yard, Esq.
Henry James Brooke, Esq.
John Bostock, M.D.
Frederick Perkins, Esq.
Major Charles Bentinck.
Frederick Dize, Esq.
William Evans, Esq. M.P.
Right Hon. Lord Prudhoe.
Sir John Compton, LL.D.

ART. XX. *Proceedings of the Royal Society of London.*

THE following papers have been read at the table of the Society, since our last Report.

MARCH 25, 1819.—Some observations on the peculiarity of the tides between Fairleigh and the North Foreland, with an explanation of the supposed meeting of the tides near Dungeness, by Capt. James Anderson, R.N.

On the ova of the opossum tribe, by Sir Everard Home, Bart. V.P.R.S. This paper was illustrated by some very beautiful anatomical drawings from the pencil of Mr. Bauer.

APRIL 1.—Results of observations made at Trinity College, Dublin, for determining the obliquity of the ecliptic, and the maximum of the aberration of light, by the Rev. J. Brinkley, D.D.

Additional remarks on the skeleton of the proteorrhachius, by Sir Everard Home, Bart. V.P.R.S.

On some new methods of investigating the sums of several classes of infinite series, by Charles Babbage, Esq.

APRIL 22.—A case of a blue child, with the dissection, by

Mr. John Freeman Wood, in a letter to W. G. Maton, M.D. (A case of mal-conformation of the heart.)

Observations on the new system of diagonal framing, introduced into His Majesty's navy, by R. Seppings, Esq., by W. Morgan, Esq., communicated by Dr. Thomas Young. In this paper Mr. Morgan gave a concise account of the various advantages resulting from Mr. Seppings's improvements in naval architecture.

May 6.—On the optical and physical properties of Tabasheer, by David Brewster, L.L.D *.

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* The most important facts contained in this paper, have been already published by Dr. Brewster, in the following extract from the *Edinburgh Philosophical Journal.* "The substance called *Tabasheer* **, has been long known in eastern countries, and formed an important article in the Materia Medica of the Arabian Physicians. In the Gentoo language it is called Vedro-Paloo, or *Bamboo milk ;* in the Malabar, Mungel Upoo, or *Salt of Bamboo* ; and in the Warriar, Vedroo Carpooram, or *Bamboo Camphor.* It is found in the joints of the female bamboo, sometimes in a fluid state like milk, sometimes with the consistency of honey, but generally in the form of a hard concretion. Some specimens of it are transparent, and resemble very much small fragments of the artificial pastes made in imitation of opal ; others are exactly like chalk ; while a third kind is of an intermediate character, and has a slight degree of translucency.

"The first person that examined the properties of this substance was Mr. Macie† (now Mr. Smithson,) who analysed a portion of the Tabasheer from Hyderabad, which Dr. Russell ‡ had the preceding year presented to the Royal Society. 'From its indestructibility by fire ;—its total resistance to acids ;—its uniting by fusion with alkalis in certain proportions into a white opaque mass, in others into a transparent permanent glass, and its being again separable from these compounds entirely unchanged by acids,' he considers it 'as perfectly identical with *common siliceous earth.*'

In the year 1804, Messrs. Humboldt and Bonpland brought with them from America some specimens of Tabasheer called *Guaduas butter* by the Creoles, taken from the bamboos which grow to the west of Pinchincha in the Cordilleras of the Andes. § These specimens were analysed in 1805,

** "Pliny clearly describes Tabasheer under the name of Sugar. The word is derived from the Persian *Scher*, or the Sanscrit *Kschiram*, signifying milk. See Humboldt *on the Natural Family of the Grasses.*

† "See *Philosophical Transactions*, 1791, p. 368.

‡ "See *Philosophical Transactions*, 1790, p. 273.

§ "Humboldt's *Personal Narrative*, vol. i. Introd. p. xiii. Note.

13.—Upon the different qualities of the alburnum of spring and winter-felled oak trees, by T. A. Knight, Esq., in a letter to the President.

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by Messrs. Fourcroy and Vauquelin[*], who found them to be different from the Tabasheers of Asia. Instead of being wholly composed of silex, they contained only 70 per cent. of this earth, and 30 per cent. of potash, lime and water.

"The Tabasheer, which I employed in my experiments, was sent from Nagpore by Dr. Moore to Dr. Alexander Kennedy, who was so kind as to favour me with a considerable portion of it. It had the same general chemical characters as the Tabasheer from Hyderabad, which was used by Mr. Smithson, the same specific gravity nearly, and the same external appearance; so that I have no hesitation in considering it as also composed principally of silex.

"When the semi-transparent specimens of this substance are immersed in water, they imbibe it with great rapidity, emitting numerous bubbles of air. The transparency increases whenever the air has been discharged, and after a few minutes the water pervades, and renders transparent the whole mass.

"If a small portion of water, on the contrary, is laid upon the Tabasheer when dry, instead of adding to its transparency as might have been expected, it actually renders it as opaque and white as chalk; and, from the same cause, the Tabasheer which has been saturated with water becomes opaque, as the water evaporates, reaches its maximum degree of opacity; and recovers its semi-transparency when perfectly dry.

"The increase of transparency from the absorption of water, is an effect easily explained, and is one with which mineralogists have been long familiar in the phenomena of hydrophanous opal; but the production of opacity, by the absorption of a smaller portion of the same fluid which produces transparency, is a fact entirely new and not easily explicable upon known principles.

"After having determined that the white opacity was not the result of any chemical change, and must, therefore, have resulted from optical causes, I attempted to frame some hypothetical explanation of the phenomenon. In tracing the progress of a ray of light through a porous body, having a small quantity of water in its pores, and through another which had these pores filled with water, I saw that opacity could be produced in the first case only upon the supposition that the Tabasheer had a refractive power considerably lower than water. Improbable as this supposition was, I immediately formed one of the semi-transparent specimens into a prism,

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[*] " *Memoirs de l' Institut*, tom. vi. p. 382.

20.—An account of certain experiments made with a view of determining the law of attraction between iron and a magnetic or compass needle, by P. Barlow, Esq., communicated by Colonel W. Mudge.

ART. XXI. *Proceedings of the Horticultural Society.*

AMONGST those scientific bodies whose proceedings we intend occasionally to communicate to our readers, there is perhaps none more deserving of notice than the Horticultural Society of London. The objects to which its attention is directed are of the first conse-

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and found, to my great surprise, that the refractive power of Tabasheer was not only lower than water, but so much lower, as to be almost intermediate between water and the gases. I repeated this experiment with various specimens from Nagpore, and also upon one from Hyderabad, with which I was favoured by Dr. Hope, and which, as it formed part of the parcel of which Dr. Russell had presented a portion to the Royal Society of London, was the same as that which was analysed by Mr. Smithson*.

"The following were the results:

		Index of Refraction.
Air		1.0000+
Tabasheer from Hyderabad, yellowish by reflected light,		1.1115
Tabasheer from Nagpore	Bluish by reflected light,	1.1454
Tabasheer from ditto, harder,		1.1503
Tabasheer from ditto,		1.1535
Tabasheer from ditto, very hard,		1.1825
Water,		1.3358

"The physical properties of Tabasheer are not less singular than its optical qualities, and indicate a structure of a very remarkable kind.

"A detailed account of my experiments on this subject, has been transmitted to the Royal Society of London, and will probably appear in the Second Part of the *Philosophical Transactions* for 1819.

"EDINBURGH, *May* 1, 1819."

* "We trust that some of the Members of the Institute of France will be induced to measure the refractive power of the Tabasheer brought from Quito by M. Humboldt, if any of it is still in existence. It will be interesting to know if the 30 per cent. of potash and lime produces any perceptible effect upon the refractive power and other properties of the Tabasheer. I have sent a quantity of the Nagpore Tabasheer to M. Berzelius, with the hope that he may have leisure to submit it to an accurate examination. As this distinguished chemist is now in Paris, he would do a service to science by comparing directly the Asiatic and American Tabasheers."

quence to the welfare of mankind, and the zeal and liberality with which that attention is given, entitle it to the warmest support and unqualified approbation of the nation at large.

Though eminently effective in its operation, the society is comparatively young; nor, until of late, has it obtained that degree of public notice to which it is so justly entitled. We shall, therefore, preface our reports of its proceedings by a brief sketch of its foundation, and the laws by which it is governed.

In the year 1804, a few noblemen and gentlemen, most of them Fellows of the Linnean Society, projected the plan of an institution, whose objects should be strictly horticultural, filling up the space between agriculture and botany. In 1808 they were incorporated by royal charter, under the name of "*The Horticultural Society of London,*" for the improvement of horticulture in all its branches, *ornamental*, as well as *useful.* Since that period, the society has been regularly advancing in numbers and consequence, and at this moment it reckons amongst its members many of the most distinguished personages in the kingdom.

Upon the death of her Majesty, who had honoured the society with her patronage, his royal highness the Prince Regent condescended to intimate his willingness to become its future patron, and expressed his wishes in the warmest terms for the success and permanence of the institution.

We cannot give a more comprehensive view of the nature of the society, than by transcribing the following passages from a statement appended to the list of its members.

" The meetings of the fellows are held on the *first* and *third* Tuesdays in every month, the chair being taken at one o'clock precisely. At these meetings, fruits, vegetables, flowers, and other subjects belonging to horticulture are exhibited ; and seeds, cuttings, grafts, and plants procured by, or presented to, the society, are distributed to the fellows present. In addition to these exhibitions and distributions, communications made to the society, on new or important subjects in horticulture, are read, and medals and premiums awarded by the council are presented. Visitors, introduced by a fellow, are admitted to these meetings.

" A selection from the papers read to the society, accompanied with figures of new or interesting fruits and flowers described therein, is published, under the direction of the council, in May and November, in Parts, forming portions of a quarto volume; these are distributed *gratis* to the fellows, after they have paid their first year's contribution.

"Every candidate for admission into the society is to be proposed by three or more fellows, one of whom must be personally acquainted with him, or with his writings. The certificate of recommendation must specify the name, rank, and usual place of residence of the candidate, who will be ballotted for after the certificate has been read at two meetings of the society. The fee to be paid on the election and admission of a new fellow is three guineas, and the contribution to the society, in each year succeeding his election, is two guineas, provided he shall have been elected *before* the first of October 1818, but if *after* that period, it is three guineas, which charge is payable on the first of May, but may be compounded for by those Fellows elected before the first of October 1818, by the payment of twenty guineas, and by those elected after that period by the payment of thirty guineas at any one time before the contribution of the current year becomes due.

"Any person exercising the trade or profession of a gardener, who shall have received a medal from the society, or shall have communicated a paper, which shall have been printed in the Transactions of the Society, may be elected, and enjoy all the privileges of a fellow, upon the payment of one guinea for his admission-fee, and of one guinea for his contribution in each year. The certificate of recommendation is in the same form, and the election is subject to the same rules as are applicable to that of the fellows."

There are three other classes of members in the society not subject to payments, from whom the greatest benefit is derived to horticulture; namely, foreign members, whose number is limited to twenty, and which consists of the most distinguished horticulturalists and botanists in all parts of the world. The second class is of foreign corresponding members, consisting of persons eminent for their horticultural pursuits, resident in distant countries; and the third class is of corresponding members resident in Great Britain and Ireland. These two latter classes are unlimited.

The society has an experimental garden at Kensington, on the south side of the road to Hammersmith, nearly opposite Holland-house, which is open to the fellows of the society, from two to six o'clock in each day of the week, except Sundays. The management of this garden is under the direction of a committee, nominated at the first council, after the anniversary. Fellows visiting the garden have the privilege of introducing one or more friends in their company.

The increasing funds of the society have enabled it to remove to a very commodious house, in which is a spacious meeting-room, in Regent-street, near Waterloo-place, where proper officers are in daily attendance for transacting business.

Having thus stated the objects of the society, and the principles upon which it is founded, we shall, in our future Numbers, record the most important matters which occur at its meetings, commencing with the notice of its proceedings from the anniversary of the society on the 1st of May last.

ART. XXII. *Miscellaneous Intelligence.*

I. MECHANICAL SCIENCE.

§ 1. ASTRONOMY, MECHANICS, *&c.*

1. *Single Microscopes of Glass.*—Mr. Sivright has devised a new method of making single microscopes of high magnifying powers, which is as follows:—Take a piece of platinum foil and make circular holes in it from $\frac{1}{20}$ to $\frac{1}{70}$ of an inch in diameter, and half an inch apart, put pieces of glass into them large enough to fill the aperture. When the glass is melted by a blow-pipe, it forms a lens which adheres strongly to the metal, and is therefore set for use. An eye or loop, made of a piece of platinum wire, may also be used in place of the foil. The pieces of glass used should have no scratch of a diamond or file on them, as a mark remains after being most intensely heated. Of lenses made in this way, those larger than $\frac{1}{70}$ of an inch, were not so good as the

smaller, and the best were less than $\frac{1}{10}$; those which contain air-bubbles must be rejected.

Mr. Sivright has also succeeded in forming plano-convex lens by fusion. A piece of glass was laid upon a plate of topaz, with a perfectly flat and polished natural surface, which is easily obtained by fracture, and the whole exposed to an intense heat. The glass fused, its upper surface became spherical from the attraction of its particles, and the lower flat and highly polished from contact with the plate of topaz.—*Edinburgh Philosophical Journal.*

2. *New Time-keeper of M.M. Breguet.*—M.M. Breguet have formed a piece of mechanism, not larger than a common watch, to be attached to telescopes, for the determination of the time in astronomical observations. This instrument enables the observer to divide seconds of time into tenths with great certainty. The instrument is adapted for the division even into hundredths, but there are few observers sufficiently expert to observe with this degree of accuracy.

3. *Asbestus used in Micrometers.*—Professor Wallace of the Royal Military College, Edinburgh, has ingeniously suggested the application of the capillary crystals of asbestus to the purposes of micrometrical fibres, and Mr. Troughton has successfully practised it. Fibres, about $\frac{1}{3000}$ of an inch in diameter, gave a line beautifully even in the instrument, and considerably opaque. The division of the substance may be carried to any extent.

§ 2. PNEUMATICS, AGRICULTURE, THE ARTS, &c.

4. *Resistance of the Atmosphere to falling Bodies.*—M. Benedict Prevost, suggests a new method of demonstrating this resistance, and its superior effect on light bodies. A piece of paper is placed flat on the bottom of a shallow cylindrical box, which is then suffered to fall from any height, the box being arranged so as to descend along the line of its axis, and with the bottom always beneath; in this case the paper will not leave the box, but falls with the same rapidity, the resistance of the atmosphere being removed from it by the box. If a small piece of paper, a bit of down, or a fragment of leaf gold, be placed flat on a large coin, and the coin be allowed to fall, so that it is always beneath, the lighter substance will descend with equal rapidity, and will afford a strong contrast to a piece suffered to float by itself in the air.

5. *Velocity of Sound.*—From the experiments performed lately at San Jago, in Chili, by M. D. Josef de Epinosa, and D. Felipe Bauza, it appears that sound moves with a velocity of 1,227 English feet in a second, the air being at a temperature of 73°,5 Fahr. barometer 27.44 inches.

6. *Spade Labour.*—Mr. W. Crowther, of Somerville Aston, Gloucestershire, states in a late Number of the *Farmer's Journal*, that manual labour by the spade, (so much ridiculed by many) is not only practicable, but profitable; and if more generally adopted, would be the means of finding abundant employment for those who want it. As evidence of the fact, he has this year 110 acres of ley wheat for which the land was prepared by manual labour only, drilling excepted, and a slight harrowing to cover the seed. He has also 30 acres of land which, four years ago, were old unproductive sward; but when labourers became plentiful, he brought the ground into cultivation by manual labour only, and has so continued it ever since, without any beast of draught being employed upon it, except for cartage and to drill and harrow.

7. *Purity of Flour.*—The following directions have been published, as affording means of ascertaining in some degree the purity of flour. 1. Grasp a handful briskly, and squeeze it half a minute, it preserves the form of the cavity of the hand, although it may be rudely placed upon the table. Adulterated flour, on the contrary, soon falls down; that mixed with whiting is the most adhesive, though it soon gives way; but if the adulteration be ground stones, bones, or plaster of Paris, it almost immediately falls. 2. Dip the fore finger and thumb in a little sweet oil, and take up a small quantity of the flour between them; if it be pure it may be rubbed for any length of time, and will not become adhesive, but if whiting be present it very speedily becomes putty, and adheres strongly; the pure flour also takes on a very dark colour from the oil, but the adulterated flour is but little altered in colour. 3. Lemon juice, or vinegar, will also shew the presence of whiting, by the agitation it produces in the flour; pure flour produces no particular effects with these fluids.

8. *Oil from Pumpkins.*—The seeds of pumpkins, which are commonly thrown away, afford abundance of excellent oil, which is said not only to burn well, and give a fine light, but to last longer, and afford less smoke than other oils. The cake remaining after the extraction of the oil may be used as food for cattle, who eat it with avidity.

9. *Russian Spirit Level.*—The Russians make their spirit levels by enclosing the alcohol in a round metallic box, covered by a strong piece of glass, very slightly concave, so as to leave a small bubble of air within. These levels indicate errors in planes supposed to be horizontal, in all directions, without any alteration of the instrument, and are in this respect much superior to the tube levels, which show errors in one direction only. The glass is fixed in the box before the alcohol is introduced which is by a screw hole in the under side of the instrument.

10. *New Substance for Paper.*—The alga marina has again been recurred to in Sweden as a substance applicable in the formation of paper. M. Ehrenhold, of Copenhagen, is the person who has lately discovered a method of working it; and, it is said, that the paper he makes is superior in whiteness and strength to any made from linen rags.

11. *Rupert's Drops.*—A very good method of exhibiting the force exerted by those singular pieces of glass on being broken, is, to immerse them in a phial, or a tall glass, filled with water; on breaking off the end with a pair of pincers, the body of the bulb is rent with such force as infallibly to break the vessel; even a stout wine bottle may be torn asunder by them in this way.

12. *Prize Subject in the Arts.*—The Society for the Encouragement of National Industry in France has offered a prize of 3,000 francs for the discovery of a metal, or composition, of moderate price, which shall not be hurtful to the animal economy, nor oxidizable either by water or the juice of vegetables, or which shall, at least, be much less so than iron and steel, without imparting any colour or taste to the substances in the preparation of which it is employed.

This metal, or composition, must possess hardness and tenacity enough to serve for crotchets, for solid files, for instruments to mash, cut, separate, and divide pears, apples, beet-root, potatoes, and other vegetable productions in common domestic use.

It is required that the inventors reveal the nature of the metals which they may employ in the case of composition, and that specimens of each of these, along with a model of some known machine, by which the necessary experiments for determining the goodness of the principal component parts may be made, shall be deposited with the Society.

The memoirs, specimens, *&c.*, to be lodged with the Society before the 1st of March, 1821, and the prize to be decreed July 1821.

Foreigners may compete, and the Society have published some observations to assist those who are desirous of making researches on the subject.

II. CHEMICAL SCIENCE.

§ 1. CHEMISTRY.

1. *On a new Acid of Sulphur and Oxygen, by M.M. Welter and Gay Lussac**.—The acid which will be the subject of this me-

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* The origin of this acid is as follows:—At the time when M. Welter directed a bleaching establishment, he had occasion to act on the oxide of

moir, ranges itself according to the proportions of its elements between the sulphurous and sulphuric acid ; but it is far removed from them in its properties and mode of composition, which does not resemble that of any other acid. We shall name it for the present the *hyposulphuric acid,* from its analogy with the hyposulphurous acid ; and to recall to mind that it contains less oxygen than the sulphuric, and more than the sulphurous acid. Its saline combinations will be called *hyposulphates.*

The hyposulphuric acid is formed by passing sulphurous acid gas into water holding the peroxide of manganese in suspension ; the combination takes place immediately, and a perfectly neutral solution is obtained composed of the sulphate and the hyposulphate of manganese. These salts are decomposed by the addition of barytes in excess, the hyposulphate of barytes being soluble ; a current of carbonic acid gas is then passed into the solution to saturate the excess of barytes ; and the whole being heated to drive off the excess of carbonic-acid which holds a little carbonate of barytes in solution, the hyposulphate of barytes is obtained. That this salt may be perfectly pure, it is advantageous to crystallize it, for otherwise it may contain a small quantity of lime, from which the oxide of manganese is rarely free. By decomposing this salt by the addition of sulphuric acid so as perfectly to saturate the earth, the hyposulphuric acid is obtained.

This acid, even at its highest state of saturation, is inodorous ; its taste is sour : it does not appear capable of existing in the gaseous state ; exposed with sulphuric acid in an exhausted receiver at the temperature of 10° (50° Fahr.) it was concentrated without being sensibly volatilized ; at the density of 1.347 it began to decompose, it gave out sulphurous acid, and retained sulphuric acid.

Heated when very dilute it gave off pure water, but began very soon to disengage sulphurous acid, and sulphuric acid was produced ; the heat of a water-bath is sufficient for this decomposition. It is not altered at low temperatures by chlorine, concentrated nitric acid, or the red sulphate of manganese. It perfectly saturates bases, and forms soluble salts with barytes, strontia, lime, oxide of lead, and probably with all the bases. It dissolves zinc without being decomposed, and with the disengagement of hydrogen. It contains two proportions of sulphur, five proportions of oxygen, and a certain quantity of water, which appears essential to its existence, when uncombined with bases. The analysis of the hyposulphuric acid is deduced from the analysis of the hyposulphate of barytes.

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manganese from which chlorine was prepared by sulphurous acid ; and he remarked, contrary to the common opinion, that a neutral bi-sulphite was formed, which he supposed to have peroxide for its base. This being communicated to M. Gay Lussac, the result was an examination made by the two philosophers in company, and the discovery of the new acid.

This salt is in shining crystals, having the form of a quadrangular prism, apparently terminated by a great number of facets. It does not suffer any change in the air, nor in a vacuum dried by sulphuric acid; 100 parts of water at 8°.14, (46°.6 Fahr.) dissolve 13.94 parts—this solution is not altered by chlorine. It decrepitates very strongly, a slight heat is sufficient to decompose it, water and sulphurous acid are disengaged, and neutral sulphate of barytes remains. 100 parts of the hyposulphate well dried in the air, lost 29.903 by heat, leaving 70.097 of sulphate of barytes. Another 100 parts of the same salt mixed with chlorate and carbonate of potash, and heated to redness in a platinum crucible, gave, after precipitation with muriate of barytes and washing, 138.3 of sulphate of barytes. This number is not quite twice 70.097, but as it is very difficult to prevent a slight loss of sulphate of barytes during washing, we may admit that the last number ought to contain twice the first. According to this supposition, the hyposulphate of barytes may be considered as formed of one proportion of barytes, one proportion of sulphuric acid, and one proportion of sulphurous acid; and if the proportion of its elements be calculated, taking 50 for the proportional number of sulphuric acid, 40 for that of sulphurous acid, and 97 for that of barytes, it will be found that 100 of the hyposulphate gives 70.12 of sulphate of barytes, instead of 70.097. The quantity of the water is deduced from the difference between the weight of the salt and that of the sulphate of barytes, and sulphurous acid obtained from it. According to this analysis, it is found that the hyposulphate of barytes is composed of

1	proportion of	barytes..........	97
1	ditto	sulphuric acid....	50
1	ditto	sulphurous acid ..	40
2	ditto	water	22.64;

or....

1	proportion of	barytes...........	97
1	ditto	hyposulphuric acid	90
2	ditto	water	22.64.

Consequently the hyposulphuric acid which neutralizes one proportion of a base, is formed of

2	proportions of	sulphur	40
5	ditto	oxygen	50
and its proportional number ought to be			90

This then is an acid which perfectly neutralizes bases, and the salts of which remain neutral on losing a proportion of sulphurous acid. It contains the same proportion of sulphur as the hyposulphurous acid, and 2.5 as much oxygen. These two acids ought to form a distinct group among the acids of sulphur, and the sulphurous and sulphuric acids will form another. The distinction is necessary, because the quantity of sulphur in each of these groups is different, and because their composition cannot be expressed by terms of the same series; the salts also of each group have stronger analogies amongst themselves, than they have with those of the other group.

In reviewing the various acids formed by sulphur and oxygen, we have the composition of the

Hyposulphurous acid	2	prop. of sulphur, and	2	prop. of oxygen:
Hyposulphuric acid	2	ditto	5	ditto.
Sulphurous........	1	ditto	2	ditto.
Sulphuric	1	ditto	3	ditto.

or, if it is desired to preserve the sulphur a constant quantity in all the acids, the oxygen combines with it in the following proportions,—1, 2, 2.5, 3.

But to return to the properties of the hyposulphates. If sulphuric acid, so diluted as not to produce much heat, be poured on one of these salts, nothing particular is observed; but if the acid be concentrated, or the mixture be heated, sulphurous acid is disengaged. This result is easily understood; hyposulphuric acid is permanent at a low temperature, but, as before stated, it is decomposed into sulphurous and sulphuric acids at a temperature slightly raised. The solutions of hyposulphates are unchanged, or at least alter very slowly in the air; in general, all these salts are very permanent at low temperatures, but are easily decomposed when exposed to the action of heat.

The hyposulphate of potash crystallizes in prisms, (cylindroides) terminated by a plane perpendicular to their length.

The hyposulphate of lime is in regular hexagonal plates, generally grouped together in distinct masses.

The crystals of hyposulphate of strontian are very small; they appear to be hexaëdral plates, with edges alternately inclined in contrary directions, similar to those formed on an octoëdron by sections parallel to two opposite faces.

The hyposulphate of manganese is very soluble, and even deliquescent. This property may be advantageously applied in separating the sulphate of manganese formed at the same time with the hyposulphate, when the oxide of manganese is dissolved in sulphurous acid, and then much less barytes is lost in saturating the solution. Indeed other bases may be employed for this object.

The formation of sulphate of manganese in the circumstances of which we have spoken, appears to us deserving of particular researches; but we have, as yet, been able to attend to it only imperfectly. According to the composition of the hyposulphuric acid, and the peroxide of manganese, it appears that nothing should be produced but neutral hyposulphate of manganese, or the sulphate.

The oxide of manganese, prepared with chlorine, gave scarcely any hyposulphate; perhaps the oxide we employed was not at the maximum of oxidation, and that there is in this respect a great difference between the various oxides of manganese. We have not been able to succeed in producing the hyposulphuric acid by treating the hydrated peroxide of barium, and the brown oxide of lead, with sulphurous acid, though these two oxides present a composition analogous to the peroxide of manganese.

In concluding, we will repeat the essential characters of the hyposulphuric acid, and its salts. The hyposulphuric acid is distinguished from the other acids of sulphur. 1. By its property of being converted into sulphurous and sulphuric acids when heated. 2. By that of forming soluble salts with baryta, strontia, lime, lead, and silver. The characters of the hyposulphates are—1. Solubility. 2. The absence of sulphurous acid when their solutions are mixed with acids, except the mixture heats of itself, or is heated purposely. 3. The liberation of much sulphurous acid at an elevated temperature, and their conversion into neutral sulphates.

Annales de Chimie, tom. x, p. 312.

2. *New Vegetable Alkali, Strychnine.*—At p. 149 of the last volume of this Journal is inserted a note, mentioning the discovery of a new vegetable alkali, by M.M. Pelletier and Caventou. It was then called Vauqueline, but has had its name improved, by being changed into Strychnine. The discoverers have since published a long paper on the subject, in the *Annales de Chimie*, from which the following extracts are made:—

Strychnine is best obtained from St. Ignatius's bean, though it is afforded by some other substances. These seeds are to be reduced to powder by a rasp, and digested in ether, by which a thick oily substance of a faint green colour is obtained, which is transparent when fluid. The ether being withdrawn, the mass is to be treated with alcohol, until all has been extracted that is soluble in that menstruum; this solution is to be filtered cold, and then evaporated, when it leaves a brownish yellow bitter substance, soluble in water and in alcohol. Both this substance and the oil have a very powerful action on animals, similar to that of the bean itself, and due to the strychnine contained in them. To obtain the latter substance pure, a strong aqueous solution of the yellow bitter matter is to be treated with solution of potash; a precipitate falls, which, when washed in cold water, is white, crystalline, and extremely bitter. If not perfectly pure, it may be rendered so by solution in acetic or muriatic acid, and reprecipitation by potash or magnesia; if the latter is used, the strychnine may be taken up from it by alcohol.

Strychnine may be obtained also from the vomica nut, by infusing it in alcohol, and precipitating the clear solution by subacetate of lead in excess; the solution drawn off from the sediment is to be cleared of lead by sulphuretted hydrogen and filtered, then by being boiled with a little magnesia, which abstracts the acetic acid, the strychnine falls, and after being well washed, may be taken up from the excess of magnesia by alcohol, and then evaporation gives it in a pure form.

Strychnine is soluble in alcohol, but nearly insoluble in water. At the temperature of 50° Fahrenheit it requires above 6,000 parts for its solution; boiling water dissolves $\frac{1}{2500}$ part. Its taste is so powerful, that a solution, containing $\frac{1}{600000}$ part, possesses it in a very marked degree. It changes to blue, vegetable colours that have been reddened by acids, and forms neutral salts with the acids. It may be obtained crystallized in minute quadrangular prisms, terminated by low quadrangular pyramids, from a solution in alcohol, containing a little water, by allowing it to crystallize spontaneously. It has no smell. It acts violently on the animal system. It is neither fusible nor volatile, but is decomposed at the temperature of boiling oil into products, consisting of oxygen, hydrogen, and charcoal.

Sulphate of Strychnine.—This salt, formed by the addition of its two elements, is neutral. It is soluble in ten parts of cold water, and in less of hot water. It may be obtained crystalline by spontaneous evaporation from this solution in small transparent cubes; but if excess of acid be present, the crystals (probably a super salt) are fine needles. The salt is extremely bitter, and is decomposed by all the soluble salifiable bases, strychnine [being precipitated. Strong nitric acid added to it gives it a deep blood-red colour. It does not change materially in the air; heated, it loses a little water, then fuses, solidifies, and is decomposed. Its constitution is

Strychnine	90.5
Sulphuric acid	9.5
	100

Muriate of Strychnine.—A neutral salt, more soluble than the sulphate, crystallizing in very fine prismatic quadrangular needles, in mammellated groups; when heated, muriatic acid is disengaged at the moment the base becomes decomposed. Its other properties are in consonance with those of the sulphate.

Phosphate of Strychnine is a perfectly soluble crystallizable salt, the crystals being quadrangular prisms. To obtain this salt perfectly neutral it must be formed by double decomposition, for it is extremely difficult to saturate all the acid by boiling it with excess of strychnine.

Nitrate of Strychnine.—This salt is made by putting strychnine in excess into very dilute nitric acid, heating the mixture, and filtering it, a colourless solution is obtained, which, carefully evaporated, crystallizes in nacreous needles, grouped together in bundles and bunches. This salt is extremely bitter, and acts more powerfully on the animal system than strychnine itself, probably from its solubility. It is capable of uniting to more acid, and if into a concentrated and saturated solution of it a little weak nitric acid be put, the super-salt immediately crystallizes in very fine needles.

When the nitrate is heated it becomes yellow; it afterwards swells up, carbonizes, and produces a hissing noise similar to the combustion of a piece of charcoal in fuzed nitre, but no light is produced, unless the salt contains excess of acid, and then deflagration occurs.

The action of strong nitric acid on strychnine is interesting. It produces, at first, an amaranthine colour, which changes to blood-red, then to yellow, which deepens more and more, and at last to green; the colour being inversely as the coloured rings of the third order. The same effect is produced by adding nitric acid to salts of strychnine, but then the red colour is more permanent. Heat also assists the action of the acid. Sulphuric or muriatic acid produces the same effect upon the nitrate of strychnine, by liberating the nitric acid, but other acids have not this power.

The change of colour produced by nitric acid on strychnine furnishes a valuable test for the presence of nitrates in mixtures of salts, or in other situations; for this purpose, a little strychnine, or salt of strychnine, is to be added to the suspected mixture with a little sulphuric acid; if a nitrate be present the red colour is produced.

If strychnine, treated by nitric acid until red or yellow, have the excess of acid removed by an alkali or magnesia, the strychnine is obtained of an orange or a yellow colour, with its alkaline powers much diminished, but still capable of forming salts with the acid, which are of a red or a yellow tint, according as it has been brought to the first or second state. If sulphuretted hydrogen is passed through a red combination of strychnine, the colour immediately disappears, and gives place to a perfect white; on heating the fluid the red colour re-appears, if a nitrate of strychnine has been used; but by separating the strychnine from a red solution by magnesia, and combining it with an acid that cannot decompose any nitrate of magnesia that may adhere to it, a red solution is obtained, which, when reduced by sulphuretted hydrogen to whiteness, cannot be re-reddened by heat alone. The proto-muriate of tin also has the power of destroying the red colour of modified strychnine, as does also the proto-sulphate of iron and sulphurous acid gas; and these effects appear to be occasioned by the abstraction of that oxygen which had been furnished by the nitric acid. The discoverers of this substance, therefore, venture the idea, that the red and yellow compounds are protoxides and deutoxides of strychnine.

Carbonate of Strychnine.—The sub-salt may be formed by double decomposition, and exists as a flocculent magma, very slightly soluble in water, but readily so in solution of carbonic acid. The super-carbonate, when exposed to the air, loses its excess of carbonic acid, and the sub-carbonate is deposited in granular crystals.

Acetic, oxalic, and tartaric acids, form neutral salts with strychnine, which are very soluble, and capable of being crystallized. They crystallize more readily when excess of acid is present. The hydrocyanic acid dissolves strychnine, and forms a crystallizable salt, that is not at all injured by evaporation to perfect dryness, being, when re-dissolved, as excellent a test for iron as before.

With sulphur and carbon, strychnine does not appear to form combinations. With iodine and chlorine, however, it exhibits phenomena exactly analogous to those produced by the fixed alcalies. If water, containing iodine and strychnine, be boiled, the colour of the iodine disappears, and the greater part of the alkali is dissolved ; when filtered a limpid liquor is obtained, which by evaporation furnishes a white salt, crystallized in needles, in the solution of which it is easy to ascertain the presence of hydriodic acid by concentrated sulphuric acid and by chlorine. It is necessary that excess of the alkali be used for the conversion of the iodine into hydriodic and iodic acids, probably in consequence of its insolubility. Chlorine acts in a similar manner to iodine. When a current of that gas is passed through strychnine diffused in water, it dissolves the alkali, and by spontaneous evaporation perfectly white crystals of muriate of strychnine are obtained. If the fluid is evaporated by heat, it becomes coloured and brown, apparently from the decomposition of the chlorate of strychnine, which is formed with the muriate.

Salts of strychnine are decomposed by potash, soda, barytes, strontian, magnesia, lime, and ammonia, the base being thrown down; it has the power, however, of decomposing most of the metallic solutions, and their decomposition by it may be effected, either by using a weak alcoholic solution of strychnine, or by boiling it with the solution to be decomposed. In some cases it forms triple salts; thus, if boiled with sulphate of copper, oxide of copper precipitates, and the solution becomes of a green colour, and this filtered and evaporated yields long needle-form crystals, of a triple sulphate of strychnine and copper.

M.M. Pelletier and Caventou have mentioned in their memoir a new acid, existing in the seeds in combination with the strychnine. It may be obtained by washing the magnesia by which the strychnine had been precipitated in its preparation, and then boiling it in a large quantity of water. The salt formed by the new acid with the magnesia is dissolved, and its solution, after filtration, is to be evaporated until considerably concentrated, and then treated with acetate of lead. The lead falls in combination with the new acid, and this being acted on by sulphuretted hydrogen, the lead is separated, and solution of the acid obtained. This acid somewhat resembles the malic; when evaporated to the consistence of syrup, and left to itself, it crystallizes in small, hard, and granular crystals. It is soluble both in water and alcohol. The taste is acid and styptic. It unites to alkaline and earthy bases, forming salts soluble in water and alcohol. Its neutral combination with ammonia does not precipitate the salts of silver, mercury, or iron, but acts upon salts of copper, producing a change of colour, and the deposition of a greenish white salt, of difficult solubility. This acid, on the supposition, though doubtingly expressed, of its being new, has received the name of the *igasuric acid.*

In continuing the analysis of the bean of St. Ignatius, it was found to contain the following principles:—

1. Igasurate of strychnine.
2. Wax in small quantities.
3. Concrete oil.
4. Yellow colouring matter.
5. Gum.
6. Starch.
7. Bassorine.
8. Vegetable fibre.

The paper concludes with an account of some physiological experiments. The principles above named were prepared perfectly pure, and experiments made with them on animals, and the result was, that the strychnine is the only active substance in the nux vomica, St. Ignatius's bean, and *bois de couleuvre*[*]. It was ascertained that the salts of strychnine were more active than the alkali itself, and that there is no substance capable of forming innocuous compounds with it; therefore remedies applied for the effects produced by it, or by the substances containing it, must act directly upon the animal, so as either to expel the poison, or diminish the spasmodic action caused by it, and prevent the injury which arises from that action to the animal.

3. *New Results on the combination of Oxygen with Water, by M. Thenard.*—I have at length been able to saturate water with oxygen. The quantity which it contains in this state is 850 times its volume, or twice that which properly belongs to it. In this state of saturation, it possesses remarkable properties, the most singular of which are the following: Its specific gravity is 1.453, and when poured into common water, it is seen to flow down through it like a syrup, although very soluble. It immediately acts on the epidermis of the skin, rendering it white, and producing smarting, which varies in duration according to the quantity of fluid placed on the skin; if it is considerable, or if fresh portions are added, the skin itself is attacked and destroyed: applied to the tongue, it whitens it also, thickens the saliva, and, with regard to taste, produces an effect difficult to describe, but which resembles that of an emetic. Its action on the oxide of silver is very violent. Each drop suffered to fall into dry oxide of silver produces a real

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[*] Lignum colubrinum, or snake-wood?

explosion, and so much heat is produced that, in a dark place, the evolution of light is very sensible. Besides the oxide of silver, there are several others which act with violence on oxygenated water, as the peroxides of manganese, and of cobalt, the oxides of lead, platinum, palladium, gold, iridium, &c. Many metals, when finely divided, also produce the same phenomena; and, among others, silver, platinum, gold, osmium, iridium, rhodium, and palladium. In all these cases, the oxygen added to the water is disengaged, and sometimes that of the oxide; but at other times, a part of the oxygen combines with the metal itself, as with arsenic, molybdenum, tungsten, selenium. These metals are acidified frequently with the production of light.

I have again had occasion to observe, very distinctly, that acids render the oxygenated water more permanent. Gold, finely divided, acts with extreme force on pure oxygenated water, whilst it is without action on that containing a little sulphuric acid.

Annales de Chimie. x. 335.

4. *Weight of Water and Air.*—Mr. Rice, in a paper published in the *Annals of Philosophy*, has taken much pains to deduce correctly the weight of a cubical inch of water, and the proportion of the weights of water and air to each other. The results are, that at the temperature of 60° Fahr., and barometrical pressure of 30 inches, 100 cubical inches of dry atmospherical air weigh 30.519 grs.; 1 cubical inch of water weighs 252.525 grs.: the specific gravity of water is to that of air as 827.435 to 1; or, reckoning water as unity, as 1 to .00120855.

5. *On the Specific Heat of Bodies, by M.M. Petit and Dulong.*—M.M. Petit and Dulong have lately been engaged in a series of experiments on heat, which, for their importance and extent, can hardly be too highly appreciated. The prospect there is of still further addition being made to what has already been given to the world by these philosophers, induces a wish to delay a general account of their researches; but wherever a complete part of their subject has received elucidation, it is of advantage that it should be made known as early and as generally as possible.

The last published researches of these gentlemen have been directed to the specific heat of different bodies. Their mode of determining this was, by ascertaining the times required by different bodies in cooling, through a certain range of temperature. Small quanties of the bodies experimented on were reduced to very fine powder, and enclosed in a small silver cylinder, with a thermometer; this cylinder was placed in the middle of a very thin vessel, blackened on the inside, and covered externally with ice; the air within this vessel was very much rarefied, and the cooling of the body introduced was observed only at temperatures from 5° to 10° above that of the air around it; the height of the mercury in the thermometer was noticed, by means of a glass, with the utmost accuracy. All these precautions were suggested by considerations on the accuracy of the experiments, which are well stated in the original memoir.

The following table contains some of the results of these experiments, and is followed by part of the reasonings of the authors:

Specific Heat*.		Relative weight of the Atoms †.	Product of the weight and capacity of each Atom.
Bismuth	0,0288	13.3	0.3830
Lead	0,0293	12.95	0.3794
Gold	0,0298	12.43	0.3704
Platinum	0,0314	11.16	0.3740
Tin	0,0514	7.35	0.3779
Silver..........	0,0557	6.75	0.3759
Zinc	0,0927	4.03	0.3736
Tellurium......	0,0912	4.03	0.3675
Copper	0,0949	3.957	0.3755
Nickel	0,1035	3.69	0.3819
Iron	0,1100	3.392	0.3731
Cobalt	0,1498	2.46	0.3685
Sulphur........	0,1880	2.011	0.3780

The second column contains the relative weights of the atoms of bodies, and is deduced from the proportions observed in the weights of the elementary substances that unite together.

It is easy, by means of the data contained in the above table, to calculate the ratio which exists between the capacities of different atoms. To this end it may be remarked that, in deducing from the specific heats furnished by observation, the specific heat of the particles themselves, it is sufficient to divide the first by the number of particles contained in equal weights of the substances compared. Now, it is evident that the number of particles for equal weights of matter are reciprocally proportional to the densities of the atoms, and therefore the result sought is obtained by multiplying each of the capacities deduced from experiment, by the weight of the corresponding atom. These are the different products contained in the third column of the table.

The mere view of these numbers shews an approximation so remarkable for its simplicity, as immediately to indicate the existence of a law susceptible of being generalized and extended to all elementary substances. In fact, these products, which express the capacities of atoms of different kinds, approach so nearly to equality among themselves, that it is impossible that the differences which may be remarked should not arise from errors, either in the measurement of the capacities, or the chemical analyses, particularly if it be observed that, in certain cases, the errors arising from these two sources, may be of the same kind, and consequently be multiplied in the results. The number and diversity of the substances on which we have operated, do not permit the relation we have stated to be considered as fortuitous, and we are therefore authorized to conclude the existence of the following law: "The atoms of all the simple substances have exactly the same capacity for heat."

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* That of water being taken as 1.

† The weight of the atom of oxygen being equal to 1.

In considering the uncertainty which still accompanies the fixation of the specific weight of atoms, it is easy to conceive that the law we have announced would change its expression, if a supposition different to that which we have admitted of the density of particles were adopted; but this law will comprehend, in all cases, the expression of a simple ratio between the weights, and the specific heats of elementary atoms, and it will be admitted that having to choose between hypotheses equally plausible, we did right to decide in favour of that which gave the simplest relation between the elements we compared. Whatever may be the opinion adopted of this relation; it may henceforth serve to control the results of chemical analyses, and, in certain cases, will offer the most accurate means of ascertaining the proportions of particular combinations.

The law stated appears to be independent of the forms of bodies, provided they are considered under the same circumstances, as may be deduced from the experiments of M.M. La Roche and Berard on the specific heat of gases. Their numbers for oxygen and azote differ very slightly from what they ought to be, to accord with the above law; and the number for hydrogen, which appears small, is so subject to various corrections, that the difference is by no means too great to be considered an error.

M.M. Petit and Dulong then notice the importance of extending the law before stated to the specific heats of compound bodies, but remark, that the difficulties here are still greater than before. The mode of operation is, of course, the same, and equally facile for compound as for simple substances; but the uncertainty in the determination of the specific weight of compound atoms is greater than for simple atoms, and would produce a greater interference. Those philosophers do not give any examples of the specific heat of compound bodies, but observe that, "The observations we have made tend to establish this remarkable law, namely, that there always exists a very simple relation between the capacity of compound atoms, and that of elementary atoms."

"We are able also to deduce from our researches another very important consequence for the general theory of chemical action; it is, that the greater or lesser quantities of heat developed at the moment of combination of bodies, have no relation to the capacity of the elements; and that in the greater number of cases this loss of heat is not followed by any diminution of the capacity of the compounds which result. Thus, for example, the combination of oxygen with hydrogen, or of sulphur with lead, which cause so great a degree of heat, produce an alteration no greater in the capacities of water and sulphuret of lead, than the combination of oxygen with copper, lead, and silver, or of sulphur with charcoal, produce on the capacities of the oxides of these metals, or the sulphuret of carbon."

Then, after noticing the hypothetical explanations of the production of heat by combination, and their insufficiency, when compared with the above deductions, M. M. Petit and Dulong observe, on the electrical states of bodies, and the theory which supposes the light and heat liberated in combustion, to be produced by the electricity of two bodies in opposite states coming together; and they remark, that the ignition of charcoal by the voltaic battery, and ignition by combustion, present an approach to identity, founded on the strongest analogies, and which deserves to be followed in all its consequences.

6. *On the mode of producing Cold, proposed by M. Gay Lussac; by Marshall Hall, M. D. F. R. S. E. &c.*—I was much interested in reading the notice given at page 177 of the last Number of the *Journal of Science and the Arts*, of a mode of producing cold, lately proposed in the *Annales de Chimie*, by M. Gay Lussac; partly because the influence of the name of that eminent philosopher will obtain for this experiment the attention it deserves; and partly because I myself proposed the same method in a letter addressed to Mr. Nicholson, and inserted in his Journal, six years ago*.

I think it may not be amiss to transcribe the letter to which I allude. It is conceived nearly in the same terms as the notice of the mode proposed by M. Gay Lussac, and is as follows:—

" The diminution of temperature observed during the exhaustion of the receiver of the air-pump, appears to suggest a principle on which the degree of artificial cold may be very much increased. The cold produced in this way appears to be proportionate to the degree and rapidity of the rarefaction of the air contained in the receiver; to increase the quantity of rarefaction, therefore, would be to increase the intensity of the cold. The quantity of rarefaction will be measured by the difference between the density of the air employed, before and after the experiment; the denser the air is before, and the rarer afterwards, and the greater the rapidity with which the change is effected, the more intense will be the cold induced.

" To generate artificial cold, it is proposed that a cylinder be filled with air, which is, by means of an accurate piston, to be subjected to a very strong pressure. The cylinder and contained air are to be cooled as much as possible, by the best frigorific mixture, and in this state the air is to be allowed to escape through an orifice into a large exhausted receiver. Any substance contained in the cylinder, or exposed to the stream of air expanding in the receiver, will have its temperature very much reduced; and as the air may be compressed to an indefinite degree, it would appear that there would be *no limit* to the degree of cold which might be produced in this manner."

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* Vol. xxxv. page 117.

I may now add, that it would be desirable that the rarefaction of the condensed air, should take place in *one* vessel only, as the effect would otherwise be *divided;* and that the principle of the rarefaction of air, might be advantageously employed *conjointly* with those of the freezing mixture, and of the elegant experiment of Mr. Leslie. It might also be well to *reverse* the experiment in which tinder is set on fire by the compression of air.

By these means an intensity of cold might certainly be produced, far greater than any to which chemical substances have hitherto been exposed; and some changes of form may perhaps be effected in several bodies, which we at present can only anticipate, as probable results of exposure to a very intense degree of cold.—*Nottingham, May* 1, 1819.

7. *Evolution of Light by the Expansion of Oxygen.*—A very curious and important experiment has recently been made by M. Biot. It consists in breaking, by means of a suitable apparatus, a ball of glass filled with oxygen gas, and placed in the receiver of an air pump, in which as perfect a vacuum as possible has been formed. The effect is to produce in a dark room a brilliant light.—*Edinburgh Philosophical Journal.*

8. *Pyrometrical Gauge.*—An imperfect but sometimes very convenient instrument to judge of the action and state of a wind furnace when in use, may be made by inserting a syphon gauge into the flue at a little distance above the fire, and filling it with water, the difference between the level of the water in the two legs of the syphon, indicates the exhaustion within and pressure inwards; and for the same furnace and fuel this will always be nearly as the air which passes through the fire, and consequently as the heat in the body of the furnace. Notwithstanding that the furnace with which I have used this instrument is an old one, and from frequent use has its walls cracked, and the various parts belonging to it warped so as not to fit accurately, by which means much air is admitted into the flue without passing through the fire: still the pressure on the gauge is equal at times to half an inch of water; and by inclining the limbs of the gauge so as to make it form an obtuse V, a scale much more extensive than this may be obtained.

I can ell with considerable certainty, by noting the pressure in this syphon gauge, when steel or iron within the furnace is in good fusion, and also when there is danger from the rising of the heat that the Hessian crucible may run; and the instrument in connexion with appearances of other kinds, has been of great use to me. It is evident that its value is derived only from practice, and that it cannot be applied with the same scale to any furnace indifferently, but in the absence of better means it may be worth attention, and particularly as it causes no trouble, and is observed with the utmost facility.

It may be remarked here, that the ascending power of the column of air in the chimney of this furnace, and which is 63 feet high, is, when the furnace is working well, equal to about $\frac{2}{3}$ of an inch of water; and that when the momentum of the moving column is added to this, it rises up to a full inch of water. M. F.

9. *Detection of Lithia.*—M. Berzelius gives the following process as a test for lithia in minerals. A fragment of the mineral, the size of a pin's head, or a small quantity of its powder, is to be heated with a little excess of soda on a piece of platinum foil by a blow-pipe, for a couple of minutes. The stone is decomposed, the soda liberates the lithia, and, the excess of alkali preserving the whole fluid at this temperature, it spreads over the foil, and surrounds the decomposed mineral. That part of the platinum near to the fused alkali becomes of a dark colour, which is more intense and spreads over a larger surface in proportion as there is more lithia in the mineral. The oxidation of the platinum does not take place beneath the alkali, but only around it, where the metal is at the same time in contact with air and the lithia. Potash destroys the re-action of the platinum on the lithia, if the lithia is not abundant. The platinum resumes its metallic surface after having been washed and heated.

10. *Action of Carbonic Acid Gas on Fruits, and the formation of Alcohol in them.*—M. Dumont, of Paris, in a letter to Count Chaptal, published in the *Annales de Chimie*, describes a considerable formation of alcohol in fruits placed in an atmosphere of carbonic acid gas. The fruits were cherries of various kinds, as the black, the sour, the hard, and those which in France are called the English cherries; they were placed in tin vessels, which were filled with carbonic acid, obtained from marble and acid; they were then (badly) corked, and placed in a cellar. They had not changed in fifteen days, but after that time, a fluid collected in the bottom of the vessels, and the fruit began to change. At the end of six weeks, a strong alcoholic odour was perceived at the apertures of the vessels; the sour cherries had lost their colour, and resembled, in the hardness of the pulp, its adherence to the kernel, and, in taste, cherries preserved in brandy,

so completely, that many persons mistook them for such in reality.

The hard cherries had altered in various degrees, some were whole, some had sunk into a soft paste; 12 lbs. of them being distilled, yielded about 6 ounces of alcohol, of 25 degrees*.

Grapes treated in the same way gave similar results. The vessels were closed by bladders tied tight over them, and the consequence was, that from the liberation of a gas, one of them burst; a small aperture being made into the other vessels, the fruits within underwent their change without producing inconvenience.

4 lbs. 12 oz. of pears, treated in the same way, had in ten weeks time produced much fluid matter in the vessel, and being distilled yielded 4 oz. of alcohol, of 19 degrees. (Sp. Gr. 935.)

Chesnuts, placed in the gas for fifteen days, had contracted an alcoholic taste, which they retained even after being boiled; others when roasted had a taste like that of a hazel-nut. They were perfectly preserved, whilst another portion of the same chesnuts, that had not been placed in the carbonic acid gas, were very soon spoiled.

11. *On the Preparation of Sulphuret of Antimony.*—The usual mode of separating sulphuret of antimony from its matrix, namely, by fusion, has been objected to by M. P. Berthier in France, on the ground that, though it appears simple in its nature, and facile of execution, it is nevertheless more expensive than the processes adopted with other ores. In the process of fusion there is much loss of sulphuret from the quantity which remains in the refuse of the matrix from that which is sublimed, from the adhesion of part to the crucibles, and from the breaking of pots in the furnace, and these, when united, make up a loss which is a heavy tax upon the process. At Licouln, in the department of la Haute Loire, where M. Berthier made many experiments on the subject, the loss amounted to one-fifth of the whole weight of the sulphuret.

M. Berthier then proposes the method of washing for the separation of the sulphuret from its matrix, and advances some experiments of the kind made in a small way, which were very successful. The method, however, appears to be applicable with advantage only when the ore is of a poor quality; when very rich, as there is then much less comparative loss by the mode of fusion, it may not be inferior to the other; but when the mineral does not contain more than ⅓ of sulphuret, the process of washing seems very much superior, the expense of preparing the same weight of sulphuret is smaller, more of it is obtained from the same weight of ore, and, further, an ore so poor that it is not worth working by the mode of fusion, may in this way be turned to good account. *Annales des Mines*, 3, p. 555.

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* If of Baumé, equal to specific gravity, 897.

12. *Subcarbonate of Potash.*—M. Guibourt, in preparing the subcarbonate of potash from a mixture of nitre, and cream-of-tartar, has observed the abundant formation of a cyanuret of potash. The mixture used was one part of nitre and two parts of cream-of-tartar; it was projected by portions into a red-hot crucible, and then heated until fused; this fused mass, when dissolved, gave the hydrocyanate of potash, and which could be destroyed only by exposure for a long time to the air. It is remarkable that, on throwing the same mixture into a crucible, scarcely red-hot, and after the deflagration preventing the further accession of heat, the mass when cold yielded a subcarbonate of potash, perfectly free from either a nitrite or a cyanuret.

13. *Alloys of Platinum.*—Mr. Fox of Falmouth has made known in the *Annals of Philosophy* some very remarkable instances of the force with which different metals combine. If about equal bulks of platinum and tin be heated to redness, in contact with each other, they will combine suddenly with great vehemence, and a very considerable extrication of light and heat, which will continue for some time after their removal from the fire. The experiment is easily made, by enveloping a little bit of tin in platinum foil, and heating it by a blow-pipe on charcoal, a sort of explosion takes place at the moment they combine, and the alloy runs about burning like ignited antimony.

The same effects took place with platinum and antimony. This alloy, when highly heated for a length of time, became solid, and very malleable, and contained little else than platinum.

Zinc also produced these phenomena in a very brilliant manner, exploding and burning at the moment of combination. Mr. Fox attributes the heat produced to the inferior capacity of the alloy, when compared with the metals, but the effect appears principally to be the results of the strong affinities brought into action in these experiments.

14. *Palm Wine.*—Some palm wine has lately been brought into this country from Cape-Coast Castle, under the direction of Captain Bagnold. This fluid, when fresh, is of the colour and consistence of milk; it is very sweet, is not inebriating, and is drank as a luxury by the natives and Europeans. When exposed to the air for a few hours it becomes slightly acid, and very intoxicating. That which Captain Bagnold possessed, and which he gave me for examination, had been obtained by tapping from the tree, Jan. 1, 1818, and it was first opened in London, April 1819.

It came in a stone-bottle, badly corked, but sealed up. When the bottle was opened it had a smell like that of fermenting beer, and the atmosphere within the bottle contained so much carbonic acid that, poured into a glass, it extinguished a taper within it The wine was a thin, milky, aqueous fluid. It was very sweet and somewhat acid; it acted readily on litmus paper, and contained both carbonic and acetic acids. When the wine was placed on a filter, it slowly passed through perfectly pellucid, leaving the white insoluble part on the filter. This, when heated in a tube, gave off abundance of ammonia, and appeared to be vegetable albumen; the clear fluid was rendered opaque, by the addition of alcohol, and the precipitated matter, on separation, was found to be gum.

Eight ounces of the wine were taken as from the bottle, and carefully distilled with a little pounded marble, until 4-5ths had come over, and this, made up to the original quantity by pure water, gave an alcoholic solution of specific gravity, 993.7, at 55° Fahr. equal to 4.7 per cent. of alcohol, by Gilpin's Tables.

The portion left in the retort was separated from the marble, and evaporated until like a syrup; alcohol was then added, which formed a sweet brown solution, and left an insoluble matter, which, dried at 212°, weighed 20 grains. It was partly soluble in water, and resembled a mixture of gum and albumen.

The alcoholic solution deposited some very minute crystals, which were supertartrate of potash, and then, being evaporated at 212° to dryness, gave a hard brown cake, weighing 167 grains, which was principally sugar. An accident prevented any experiments on the quantity of salts contained in this portion of the wine, and, with the exception of a very minute quantity, no more was to be obtained.

M. F.

15. *Analysis of the Liver.*—M. Braconnot has lately analyzed the liver of an ox with the following results: 100 parts gave,

Vascular tissue and membranes	18.94
Parenchyma	81.06
	100.

100 parts of the parenchyma, or proper substance of the liver, contained,

Water	68.64
Dried albumen	20.19
Matter with little azote, soluble in water, and slightly so in alcohol	6.07
Phosphuretted oil, soluble in alcohol, and analogous to that of the brain	3.89
Muriate of potash	.64
Ferruginous phosphate of lime	.47
Acid salt insoluble in alcohol, formed of a combustible acid with potash,	.1
Small quantity of blood	
	100.

16. *Caseic Acid and Caseous Oxide.*—M. Proust has published, in a late number of the *Annales de Chimie*, some researches on the fermentation of gluten and the curd of milk, in which he describes two new substances, the product of these fermentations, a combustible acid and a combustible oxide; and in consequence of their existence in cheese, being the substances which give it flavour, he has named them the caseic acid and the caseous oxide.

When gluten is placed under water, in a temperature of 50° Fahrenheit, it undergoes a change, swells in volume, and liberates much gas. A pound of gluten, which occupied a volume of thirty-six cubical inches, after some days gave out eighty-five cubical inches of gas, of which forty-eight were carbonic acid gas *, and thirty-seven pure hydrogen. After the gluten had suffered this change it was broken down, and put into a bottle containing water enough to cover it a few inches, and the mouth of the bottle closed by a glass plate; no more gas was liberated, but acetic, phosphoric, and *caseic* acids were produced, all of them saturated by ammonia. If during this spontaneous action of the elements of the gluten the water is allowed to evaporate, the decomposition ceases; but if the mass is retained in a moist state, the products above-mentioned continue increasing until the water above the gluten is so much charged with them as to become a sort of brine, sufficiently strong to prevent any further change. In this case the fluid should be withdrawn, the gluten should be washed and replaced in water, for the continuance of its decomposition, and the formation of more of these products.

The fluid and the washings are to be evaporated carefully in a silver basin, during which much carbonate and acetate of ammonia separates, until a thick syrup is obtained, and this left to itself for a few days solidifies into a saline mass, slightly transparent, and having an extremely acrid and unpleasant taste of cheese. This mass is to be covered with alcohol and agitated with it; the whole becomes turbid, and an abundant white powder separates which is to be washed with alcohol, until deprived of any cheesy taste. This is the *caseous oxide*.

The caseic acid, combined with ammonia, is taken up by the alcohol, together with other substances; the solution is to be put into a narrow bottle, or flask, and every two days two ounces of very pure alcohol is to be added; this causes the separation of a portion of gum, in the form of a fluid, from which the supernatant fluid is to be poured; and, on being distilled, a saline mass is obtained, free from gum, and consisting of carbonate, acetate, phosphate, and caseate of ammonia. To separate these the mass is to be dissolved in water, and boiled with two ounces of carbonate of lead, free from lime; in this way the ammonia is dissipated, and the acids form salts with the lead; on making a solution and filtering, the phosphate remains behind, and the filtered liquid contains acetate and caseate of lead only. A current of sulphuretted hydrogen is now to be passed through the solution, until all the lead is thrown down; the free acids are to be separated, by filtration, and, on being distilled, are parted from each other, the acetic acid going over, and the caseic acid remaining in a state of purity in the retort.

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* This, of course, could not be all the carbonic acid gas liberated by the gluten, as the experiment was made over water.

Caseic Acid is of the colour and consistence of syrup. Its taste is acid, bitter, and like that of cheese. It reddens litmus paper. It congeals into a granular transparent mass like honey. It does not in this state affect lime-water, muriate of tin, or acetate of lead. It precipitates nitrate of silver, white; muriate of gold, yellow; and corrosive sublimate, white; but does not change solutions of those metals, having stronger attractions for oxygen. With an infusion of gall nuts it produces a thick white precipitate.

Chlorine does not change it. Nitric acid rapidly converts it into oxalic acid, forming at the same time a little benzoic acid, and some of the yellow bitter principle. When the acid is distilled it gives the common products of animal matter.

The caseate of ammonia has a sharp saline taste, bitter, and like that of cheese, accompanied ultimately with the taste of roast meat. The salt does not crystallize. It is always acid, and reddens litmus; and if saturated with ammonia becomes acid again by exposure to the air for twenty-four hours. Potash liberates ammonia from it, and forms a compound with the caseic acid, which has no taste of cheese, and which, like the caseate of ammonia, appears incapable of being crystallized.

The caseous oxide may be purified by being boiled in water, and filtered whilst hot; the fluid is to be evaporated considerably, when films and crust of the oxide form. When cold it is to be filtered, and washed with cold water. It is then a light white and spongy substance like the agaric, and future solutions and evaporations do not alter it.

It is so light as to float on both hot and cold water, and the water does not appear to moisten it. It begins to dissolve at about 140° Fahrenheit. It is soft to the touch, crumbles under the fingers, and leaves a peculiar greasy impression when pressed hard. It is tasteless, but its hot solution has a slight taste of the crumb of bread, and emits an odour of the same kind. It is combustible, and produces a white flame.

Boiling alcohol dissolves very little of it, and it separates, on cooling, in crystalline grains. Hot ether does not touch it.

Acids and alkalies do not affect its solution, but potash dissolves it rapidly. Nitric acid dissolves it, and, with the aid of heat, converts it into oxalic acid, and yellow bitter principle.

When moderately heated the greater part of it sublimes, but part, which has been more heated, is decomposed; the results are an abundant yellow oil, which congeals, very little water, and so little ammonia that it requires attention to test its presence. Its charcoal resembles that of distilled oleaginous bodies. The oil produced by this distillation has nothing of the acrid odour belonging to the results of distilled oil, but has a peculiarly fetid alliaceous smell.

These two bodies are also produced abundantly by the curd of milk, during its spontaneous change. According to Mr. Proust, the caseate of ammonia produced in this way, is the odorous and sapid principle of cheese, giving to it its principal characters. Caseous oxide occurs frequently in cheese in detached points, as in those of Gruyere and Roquefort, forming those small particles which affect the teeth, like an earthy and dry substance. A cheese from Villalare gave $\frac{28}{100}$ of a mixture of the acid, the oxide, and a little gum, on analysis. Cheese from Gruyere yielded $\frac{34}{100}$; from Roquefort $\frac{30}{100}$; from Oviedo (a rare cheese) $\frac{36}{100}$. All these extracts were attended with a taste of roast meat, and the remaining part, even of the most savoury cheese, was nothing but a yellow pulp of a stale and nauseous taste.

17. *Pyroligneous Acid.*—The pyroligneous acid, or impure acetic acid, obtained by the distillation of wood and vegetable substances, has been applied, it is said, with great success to the preservation of animal and vegetable substances. Meat plunged for a short time into it may be preserved fresh for many months afterwards, and, when dressed, proves excellent. This effect has been applied to explain the preservation of hams, smoked beef, tongues, sausages, red-herrings, *&c.*

18. *Prize Question in Vegetable Chemistry.*—The subject proposed by the Academy of Sciences, at Paris, for the present year, namely, "to determine the chemical changes which take place in fruits, during and after their ripening," not having been treated according to the conditions annexed to the prize, is again offered to the scientific world for the year 1821. The conditions are, that analyses be made of the fruit at the principal periods of its growth and ripening; also at the time of its decay and spontaneous decomposition. That the nature and quantity of the substances found in the fruits at those times be compared together; and that the influence of external agents on the fruits be examined, particularly that of the air; and also the changes it suf-

fers. The observations may be confined to a few fruits of different species, but so arranged as to allow of general deductions.

The prize is a gold medal of 3,000 francs value, and the time allowed for the reception of papers is till January 1, 1821.

19. *On the Separation of Lime and Magnesia, in a letter from Mr. Cooper to the Editor.*

Dear Sir,—The 12th number of your Journal contains a paper by Mr. Richard Phillips, on the separation of Lime and Magnesia. The method which he proposes consists in washing the mixed sulphates of these earths with a solution of sulphate of lime, which, dissolving the magnesian sulphate, leaves the calcareous one unacted upon.

Admitting Mr. Phillips's discovery of this process, I beg to state, that previous to the publication of his paper, I had not only adopted the method proposed in it, but had employed it in analysing several magnesian limestones, with very satisfactory results.

I am induced to make this claim of priority of discovery, to prevent those chemical friends to whom I imparted it before the appearance of Mr. Phillips's paper, from supposing that I had borrowed it from him, which certainly was not the case; the present instance may therefore be added to numerous others, which show, that those who pursue the same object may attain it by the same means.

It does not however appear by Mr. Phillips's paper that he made any direct experiments upon known quantities of lime and magnesia, to ascertain, if he gets exactly the whole of these substances separated in combination with the sulphuric acid; his experiments went no farther than to prove that a saturated solution of sulphate of lime would dissolve sulphate of magnesia. I carried my experiments further than this, by taking 50 grains of pure crystallized carbonate of lime, and 30 grains of recently prepared magnesia, weighed while it was warm. I dissolved these together in nitric acid, and evaporated the solution nearly to dryness. I then converted the nitrates into sulphates, evaporated, and heated the mass to redness, to expel all the water and uncombined sulphuric acid; the dry mass was then weighed while warm*, which was found to be 158.5 grains. I then powdered it, and poured on it about twelve times its weight of saturated solution of sulphate of lime, which was prepared by boiling recently calcined sulphate in distilled water, and either allowing the excess to separate *per se*, or by the filter; after repeated washing with this solution, the sulphate of lime which remained on the filter was dried, heated red hot, its weight was found to be 67,8 grains—now if this weight be deducted from that of the joint weights of the double sulphates, we shall have 158.5—67,8=90,7=the weight of sulphate of magnesia. This accords, as nearly as possible, with the weights we ought to obtain, for if we suppose 50 carbonate of lime, to be composed of 28.4 lime, and 21.6 carbonic acid, and this 28.4 of lime to combine with 39,2 sulphuric acid, this will make the sulphate of lime 67,6, which is a difference of only .2 of a grain, and is as near as we can ever expect to approach by direct experiment.

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* It is necessary to weigh the double sulphates before they become cold, or are exposed long to the air, otherwise they combine so rapidly with the humidity of the atmosphere, as to increase their weight many grains.

Again, 30 magnesia combine with 60 sulphuric acid, which will make the sulphate of magnesia, we ought to obtain 90 grains; but by experiment it amounted to a trifle more for 158.5—67.8 =90.7; here there is a difference amounting to .7 of a grain; but I do not conceive in practice, that an error so small, amounting to only $\frac{1}{136}$ part of the whole, can ever be of much consequence; at any rate it approximates much nearer the truth, than by any other mode of operating.

I should here state, that this is not the only experiment I have made, but have repeated it more than fifty times on different artificial and natural compounds, and found in all of them, the results to coincide as nearly as possible.

I am, dear Sir,
Your's respectfully,

89, *Strand, June* 4, 1819. JOHN THOMAS COOPER.

§ 2. METEOROLOGY, ELECTRICITY, MAGNETISM, *&c.*

20 *Meteoric Stones of China.*

The following account is taken from a paper by J. P. Abel Rémusat, in the *Journal des Sçavans.* It is part of a catalogue of meteoric stones that have fallen in China, made on the authority of *Ma-touan-lin,* and containing an account of about 60 instances.

In the sixth year, *Youan-ho* (811) in the third moon, on the day *Wou-siu,* between the third and fifth hour after mid-day, the sky being cloudy, and the weather cold, there appeared a globe of fire, as large as a *hou* (a measure equal to about 10 bushels,) which fell between *Yan* and *Yun.* A noise resembling thunder was heard at many leagues distance, and the people fled with violent outcry. Above the place where the globe fell, a reddish vapour remained, arranged like a serpent, and a *tchang* (12 feet 6 inches nearly) in length; it remained till the evening, and then disappeared. The twelfth year (817,) in the ninth moon, on the day *ki-kaï,* about the third or fourth hour after midnight, there appeared a running star towards the middle of the heavens; its head was like a bucket, and its tail like a bark of 200 *hou* burthen; it was more than 10 *tchang* (124 feet 8 inches) in length, and made a noise like a number of birds flying; it produced a light similar to that of the torches used in illuminations. It passed beneath the moon, moving towards the west; on a sudden a great noise was heard, and at the moment the globe fell to the earth, a crash took place thrice as great as that of a falling house.

The second year, *thian-yeau* (905,) in the third moon, on the day *i-tcheoü*, towards midnight, there appeared a great star in the middle of the firmament; it was of the size of 5 bushels; it ran to the north-west side, about 10 tchang (124f. 8in.) when it stopped. There was above it a multitude of small stars, which formed the appearance of a flame, of a red or orange colour, at least 5 tchang (62f. 4in,) in length, and prolonged like a serpent. All these small stars moved towards the south-east, and then fell in the manner of rain. Shortly after which the globe was extinguished. There remained a vapour of a whitish blue colour, approaching to green, which occupied the middle of the heavens; this colour became more and more obscure, and at last disappeared.

In the year *wan-li*, of the dynasty of Ming (1516,) in the twelfth moon, on the 25th day, at *Chun-khing-fou*, in the province of *Soe-tchhouan*, there was neither wind nor clouds, when the thunder rumbled suddenly, and six globular stones fell, of which one weighed 8 pounds, another 15 pounds, and a third 27 pounds; the smaller did not weigh more than a pound, and the smallest of all 10 ounces only.

In the reign of *Wen-tsoung*, king of Corée, which answers to the second year of *thyan-yeau* (905,) there fell at *Hoang-lie* (in Corée,) stones which imitated the noise of thunder. The officers of the place having sent these stones to the court, the president of the ceremonies said, in a petition addressed to the king, that from the time of *Thesin* (he should have said from the time of *Tcheau*,) stars had fallen; and that, under the dynasties of *Tsin* and *Thang*, and, in after times, the same event had occurred from time to time, so that it became a common thing, and not a prodigy, announcing misfortunes or successes, and that it ought not to occasion astonishment.

Certain stones, of a black or violet colour, are called thunder hatchets, scissors, hammers, wedges, gimblets, rings, pearls of thunder, or rather of the god of thunder. Their form approaches a little to the objects after; which they are named, and it is reported that they fall with the production of thunder. The hammers sometimes weigh many pounds, and the wedges are a *tchhi*, or Chinese foot, in length. All these objects resemble steel or iron. Many wonderful histories are told of them, but the Chinese author, from whom the above instances are taken, rejects all these, and explains them according to the phantastic principles of Chinese philosophy. His most sensible observation is, that these supposed tools of the god of thunder are of the same nature with falling stones. In the history of Japan it is recorded, that in the sixth year, *siowa*, of the reign of *Nin-Mio Ten-O* (839,) the 29th day of the eighth moon, there occurred at a place to the west of the town of *Thean-tchhenan*, where no fragments of stone previously existed, thunder and rain for ten days. The weather having become clear, stones similar to the points of arrows and to hatchets, were found on the earth, some being white and others red. There is another example of similar observations made in two other towns of Japan, and which were renewed during three succeeding years, in the reign of *Koucko-Ten-O*, in the years *nenwa*, *i. e.* in 885, 886, and 887.

It is said in Japan, that thunder stones are much more common towards the north, than in Japan, where they are somewhat rare, and some insufficient proofs of this are given. Another conclusion may be drawn from these Chinese and Japanese accounts, more remarkable, and of greater value, namely, that in the greater number of cases the *lieou-sing*, or the ignited globe, which produced the falling stones, has been observed before their fall, and appeared to be the immediate cause from which they originated.

21. *Meteors.*—A very remarkable meteor was seen at Aberdeen, on Wednesday, May 5th. At about half past 12 o'clock in the day it appeared at an altitude of nearly 36°, having the form of a ball of fire, with a short tail, darting towards the earth. The atmosphere was uncommonly clear at the time, with bright sunshine, and no clouds. In about *five minutes* after it was observed, it exploded with a considerable noise, and a volume of smoke issued from it, which assumed the form of a small white cloud. The same meteor was seen in many parts of the country. In the parishes of Kintore, Fintray, *&c.*, the noise of the explosion was so loud that the cattle in the fields became terrified, and bellowed loudly.—SCOTSMAN.

On the 5th of June, a remarkable meteor was seen near Lowisk, in the neighbourhood of Berwick, at about five minutes past 12 at noon, the sun shining bright at the time, and the sky clear; it had the appearance to the observer, when first noticed, of a brilliant ball of fire, and afterwards appeared like a flaming sword, pointing downwards towards the earth, in a direction above Berwick; its course appeared to be northerly, and at a great distance from the earth.—CHRONICLE.

22. *New Hygrometers.*—Mr. Adie proposes, in a paper printed in the *Edinburgh Philosophical Journal*, to use the internal membrane of the arundo phragmites in the construction of hygrometers, by forming it into a bag at the end of a fine tube, and then filling it and part of the tube with mercury. Instruments made in this way are described as extremely sensible, and very uniform among themselves, though liable to changes, resulting from variations of temperature, and the natural tendency of or-

ganized matter to alter. The former influence, Mr. Adie states, is considerably counteracted by making the glass tube go through the bag, to which it is tied above and below, and causing a lateral communication for the mercury by some holes in the side of the tube. Portable hygrometers may be made, by attaching a slip of the same membrane to the end of a lever, which then marks, in a magnified degree, the extent of its contraction and expansion.

Mr. Livingstone, of Canton, describes, in the same Journal, an application made by him of the old hygrometrical substance, sulphuric acid, to the same purpose. Having observed, in the process of making ice, that the power of the sulphuric acid was remarkably equal, from the point of its highest concentration, until it had been used twelve or fifteen times, he hoped it might be so in a more diluted state, and, finding it answer his wishes, he constructed a hygrometer in the following manner: A small porcelain dish, containing 21 grains of sulphuric acid, of 1.845, and 29 grains of water, were balanced, and, being exposed to air, of the greatest degree of artificial moisture, gained 50 grains in 24 hours; afterwards placed for a night, in a close vessel, over concentrated sulphuric acid, it lost 50 grains. Half a grain made the edge of the scale of the balance describe an arch exceeding an inch, both above and below the level; the whole space, equivalent to a grain, was divided into 20 parts, and this, multiplied by the difference of 50 grains, gave a scale of 1,000°, between the extremes of moist and dry. When used, the instrument was placed under a glass cover, sufficiently open below to admit the air freely, and Dr. Livingstone expresses his conviction of its superior accuracy to any other. It frequently, in the atmosphere, approached within a few divisions of the point of greatest humidity, and also within 143 of extreme dryness. Another mixture of 2.1 grains of acid, and 2.9 grains of water, gave a scale of 100°, and was very sensible. A remarkable instance of rapid change in the hygrometrical state of air, is noticed, as observed by this instrument. It pointed to 950° (or the mixture weighed 9.5 grains,) at Macao, on the 7th of Feb. 1817, as the time of a very thick fog; it continued so that evening, but next morning, at 7 o'clock, the wind having changed during the night from S. W. to N. E., it had lost 4.5 grains, or had fallen to 100°.

Glass covers to the pans, and other additions, are suggested as tending to prevent the interference of dust or any other disturbing causes.

23. *Earthquakes.*—1. On the 2d of October last, about half-past 1, P. M., a very smart shock of an earthquake was felt at Brutensorg, Batavia. The houses were violently shaken, the windows rattled, the mortar fell from the walls, and the bells rung; people who were standing up became giddy by the motion of the ground. Some houses had the walls rent open. The shock lasted only a few seconds. It was felt in the mountains as well as in Batavia.

On the night of January 29th, several shocks of an earthquake were felt at Teflis in Georgia; they were preceded by tempestuous weather and subterranean noises. About 10 o'clock they became very violent, the earth was rent in many places, and many old buildings were destroyed.

On the 26th of February, an earthquake was felt at Rome, Frescato, and Albano. Its direction was from S.E. to N.W.

A letter from Palermo of the 4th of March, states that during the fourteen preceding days, the weather had been dreadful, and that three shocks of earthquakes had occurred. Much mischief was done by the shocks on the south-east part of the island, churches being thrown down and villages destroyed. Much damage was also done among the shipping; but none occurred at Palermo.

Three shocks of an earthquake were felt at Temeswar, in Hungary, on the 8th of April.

A slight shock of an earthquake was felt at Landshut and Augsburgh, on the 10th of April.

It is stated, in accounts from Rome, that a violent shock of an earthquake was felt at Corneto on the 26th of May, which considerably damaged several edifices, but no lives were lost. The celebrated Cupola il Castello, remarkable for its antiquity and its Gothic architecture, was thrown down, and the church of the Minor Friars, of which it formed a part, was so much damaged as to be rendered useless for the present. The shock is stated to have been felt along the whole coast of the Mediterranean.

24. *Pyro-Electricity of the Tourmaline.*—The electricity of this mineral may be shewn in a very satisfactory and beautiful manner, by means of a thin slice taken from any part of the prism. In order to perform the experiment with most advantage, the slice should have its surfaces perpendicular to the axis of the prism; it must then be placed upon a piece of well-polished glass, and the glass heated to a considerable degree: at the proper temperature, which is about that of boiling water, the slice will adhere to the glass so firmly, that even when the glass is above the tourmaline, the latter will adhere to it for 6 or 8 hours. By this means, slices of a very considerable breadth and thickness develope as much electricity as is capable of supporting their own weight. The tourmaline adheres also to all *metallic* bodies, to wax, and all minerals that have been tried.

Mr. Sivright has fitted up a tourmaline, so as to bring the action of its two poles very near to each other. It resembles the letter D with an opening on the curved part; the straight part represents the tourmaline, and the two curved parts are pieces of silver wire, rising out of two silver caps, one of which embraces each end of the tourmaline. When a pith ball is suspended at the opening between the extremities of the wires, it will vibrate in a very beautiful manner.—*Edinburgh Philosophical Journal.*

25. *Magnetism by Light.*—The discovery of M. Morrichini is so curious, and would be, if established, so important, that it is necessary to prevent if possible any erroneous opinion on the subject, by making known every experimental authority both for and against it. Dr. Carpi, Count Ridolfi, and Mr. Playfair, have succeeded in getting results in harmony with those of M. Morrichini, but others have tried in vain. M. Dhombres Firmas has lately published an account of his experiments, which were unsuccessful, though made apparently with all possible caution, and varied according to the directions of the above-named philosophers.

III. NATURAL HISTORY.

§ 1. BOTANY.

1. *Tea-Shrub at Katmandu.*

Extract of a letter from Calcutta, (29th October, 1818.)—The British Resident at the Court of Nepal (Hon. E. Gardner), has lately discovered a fine *tea-shrub*, in the garden of a Cashmirian, at Katmandu, originally brought from China, and growing with vigour, and producing ripe seed yearly. He has also found a species of Camellia, on the mountains of *Sivapur*, where the tree is called *Kísí*. It resembles, as very properly remarked, the real tea; and comes very near to Thunberg's Camellia Jakanqua, but differs in the fruit.

The utmost exertions will be used to effect the introduction of those invaluable trees, into such of the British possessions, towards the north and west, as may hold out prospects of success in their cultivation.

Specimens of Valeriana Jatamansi (Spikenard) and Gentiana Chirayta, have been received from *Gosain-than*, a wild and desolate place at the foot of the *Himálaya* mountains, situated to the northward from Katmandu, seven or eight days journey thence, and greatly elevated above the valley of Nepal.

From the same quarter, a very great number of undescribed plants, not less than twelve hundred new species, have been received at the Botanic garden—both dry specimens, and growing plants, or ripe seeds. Among those particularly mentioned, are some splendid Incarvilleæ, several Gerania, and Convallariæ, innumerable Orchidæ, and some fine Liliaceæ; especially a stately one-flowered nutant Lily, approaching to the Lilium Japonicum of Thunberg.

These productions of the cold and rugged regions, at the foot of the snowy mountains, may be expected to prove hardy plants, capable of sustaining the rigour of an English climate, when introduced, as doubtless they will be, into Great Britain; where many will be found useful objects of culture, and others ornamental.

Among useful plants may be specified kitchen-garden ones, indigenous of Nepal; such as the immense *Newar* radish, and a cucumber, of which a specimen in the Botanic Garden, measured 17 inches in length, 25 in girth, and weighed 507 sicca weight, (12½ lbs.)

§ 2. MINERALOGY, GEOLOGY.

2. *English Gold.*—Some fine specimens of native English gold have been presented to the Royal Institution, by Sir Christopher Hawkins, Bart., through the hands of Earl Spencer. They were found lately whilst streaming for tin, in the Parish of Ladock, in Cornwall: some of the pieces weigh each 60 grains.

Native English gold has also been found lately in Devonshire, by Mr. Flexman, of South Moulton. It occurs in the refuse of the Prince Regent mine, in the Parish of North Moulton; the mine was discovered in 1810, and worked for copper, but was discontinued in May 1818. The refuse is a ferruginous fragmented quartz rock, and contains the gold in imbedded grains and plates. Gold has been reported to be found in some other mines in that neighbourhood.

3. *Native Copper.*—A remarkable piece of native copper, was lately found near the town of Wallingford, twelve miles from Newhaven, United States. The country is according to the Wernerians of the secondary trap formation, and the rocks at the place where it was found are of the old red sandstone, which here occupies the plains, and runs under the trap. The piece, which was turned up in ploughing, weighed almost six pounds. It was virgin copper, with rudiments of large octoedral crystals of native copper on its surface. It was more or less incrusted with green carbonate of copper and ruby oxide, very much resembling that of Cornwall. A piece of nearly 90 pounds weight was found in the same neighbourhood several years ago.

4. *Analysis of a Stone used in the setting of fine Cutlery.*—In the Supplement to the *Encyclopædia Britannica*, article CUTLEYR, mention is made of a green stone as the only known material capable of giving to lancets, and other delicate instruments, the smooth and perfect edge, that is essentially necessary to their performance: this valuable material is stated to be found in some parts of the old pavement of London. Being furnished with a very fine specimen, by my friend Mr. Stodart, I, at his request, submitted it to an analysis, and obtained the following proportions per cent:

Water	3.33
Silex	71.33
Alumine	15.33
Protoxide of Iron	9.33
Trace of Lime.	
	99.33

In consequence of the great value of these stones when very good, the piece from which the above numbers were obtained was but small, weighing only 15 grains; but from the analysis having been twice made, and from the added numbers approximating so nearly to the quantity operated upon, I have no reason to doubt the correctness of the result. The stone itself is a soft hornstone.

M. Faraday.

5. *Analyses of some Minerals containing Lithia, by M. Arfwedson.*

Petalite from Uto' specific gravity, 2.421

Silex	79.212
Alumine	17.225
Lithia	5.761
	102.198

Triphane from Uto'

Silex	66.4
Alumine	25.3
Lithia	8.85
Oxide of Iron	1.45
Volatile matter	45
	102.45

M. Arfwedson observes that he does not know how to explain the surplus which occurs in these two analyses, but that he is certain they do not come from impure tests, and that every care was taken in the washing and other manipulations.

Green Tourmalin, or crystallized Lepidolite.

Silex	40.30
Alumine	40.5
Lithia	4.3
Oxide of Iron	4.85
Oxide of Manganese	1.5
Boracic Acid	1.1
Volatile Substances	3.6
	96.15
Loss	3.85
	100.00

Afhandlingar i Kemi Fysick och Mineralogie, T. 6.

6. *Analysis of the Garnet from Fahlun.*—M. Hisinger finds the large garnets which come from the copper mine of Fahlun, to be composed of

Silex	39.66
Alumine	19.66
Protoxide of Iron	39.68
Oxide of Manganese	1.8
	100.8

7. *Temperature in Mines.*—The curious observations made by Mr. Lean, on the increase of temperature in descending into the mines in Cornwall, were noted at page 371 of the last volume of this Journal. The following data of a similar kind are taken from a paper by Mr. Bald, in the *Edinburgh Phil. Journal.*—At Whitehaven Colliery, Cumberland; water at the susface was 49°; at the depth of 480 feet, 60°; giving a difference of 11°. Workington Colliery, Cumberland;—A spring at the surface 48°. Water at 180 feet from the surface 50°; at 504 feet, where it was beneath the water of the Irish sea, 60°; making a difference of 12°. Teem Colliery, Durham;—Average temperature of water at the surface 49°; water 444 feet deep 61°, difference 12°. Percy Main Colliery, Northumberland;—Average temperature of water at the surface 49°; at a depth of 900 feet from the level of the sea, and beneath the bed of the Tyne, 68°, difference 19°. Jarrow Colliery, Durham;—Average temperature of water at the surface 49°; water at the depth of 882 feet, 68°; difference 19°. Killingworth Colliery, Northumberland;—Average temperature of water at the surface 49°; water at 1,200 feet from the surface 74°; difference 25°.

It is observed, with respect to the extraordinary depth of the last mine, that the temperature of boiling water at the bottom of it was 213°.

§ 3. Medicine, Anatomy, &c.

8. *Medical Prize Question.*—The Medical Society of Paris has proposed the following question; for the best reply to which a prize of 300 francs in value will be awarded in December 1819. "Is there any doubt respecting the existence of idiopathic fever?" The memoirs are to be written in French or Latin, and sent, free of expense, to M. Nacquart, Secretary to the Society, Rue Sainte Avoie, No. 39, before the 1st of November.

The subject proposed last year by the Society, "To determine the nature, causes, and the treatment of internal hæmorrhages from the uterus, arising during pregnancy, in the course of parturition, and after delivery, not having been satisfactorily treated, it is again proposed for the present year, the premium and other circumstances being as above.

The Medical Society of the Department of the Eure has proposed the following question :—" To determine the nature, character, causes, differences, and treatment of ascites." The prize a gold medal of 200 francs value ; and a silver medal to the author of the second best memoir. The papers, written in French or Latin, are to be sent to M. L. H. Delarue, Pharmacien à Evreux, before the 1st of August, 1819.

9. *Anatomical Prize Question.*—The Royal Academy of Sciences of Paris have announced the following subject of a prize essay. The reward to be a gold medal of 3,000 francs value, to be adjudged in March 1821.

" To give a comparative description of the brain of the four classes of vertebral animals, and particularly of reptiles and fishes, endeavouring to discover and establish the analogy of the various parts of this organ, describing with care the changes of form and proportions which it suffers, and tracing to the utmost the roots of the cerebral nerves. It will be sufficient to make the observations on a certain number of particular genera, chosen from among the principal natural families of each class ; but it is required that drawings be given of the principal preparations, so accurate as to enable others also to prepare them, and verify the observations."

The papers are to be sent to the Secretary of the Academy, free of expense, before January 1, 1821, each having a motto, or design, which is to be repeated on a sealed note, containing the name of the author.

10. *Animal Magnetism.*—It is curious to observe the different feelings with which this pretended science is received on the Continent. In Austria, at the latter end of last year, all those physicians, not matriculated at the University of Vienna, were called together, in order to be officially informed of a resolution taken by the supreme powers, by which the practice of animal magnetism is generally prohibited throughout that country ; and several of the doctors of Vienna have been publicly censured as empirical practitioners of the art, and threatened with suspension of their functions, should they still resort to it. On the contrary, in Prussia it is encouraged, and the class of physical sciences of the Academy of Berlin has proposed, by order of the Prussian government, a prize of three hundred ducats for the best explication of the phenomena of animal magnetism, and of the experiments made down to the latest period, divesting them of the marvellous which has hitherto been mingled with them. It is to be feared, that thus purified, the science itself will disappear.

IV. GENERAL LITERATURE.

1. *Pompeia.*—The workmen employed in making researches among the ruins of this celebrated city, have lately discovered a bronze vase, incrusted with silver, the size and form of which place it very forward amongst the articles of this description which form so interesting a part of the Bourbon Museum, and also a bronze statue of Apollo, of admirable workmanship, which is indisputably the finest in the gallery. The beauty of form, and the life of the figure, is described as being beyond description. The deity is represented as sacrificing, with his avenging arrow, the family of Niobe.

2. *Roman Medals.*—On the 1st of March, some monks of one of the convents of Namur, working in a piece of ground belonging to the convent, found, about a foot under ground, a vessel of baked earth, which contained about 2,000 Roman medals or coins. Most of them are of bronze, and some of silver. Among these medals there are some of Gallienus, of Gordian, Claudius, &c. They are in the possession of the directors of the convent to whom the monks delivered them. The place where they were found is a small hillock, on the left bank of the Meuse, about a quarter of a league from Namur. The vessel was broken into a multitude of small pieces.

3. *Hieroglyphics in Sweden.*—M. Brunins, of the university of Lund, in Sweden, has discovered a considerable number of inscriptions cut in rocks, and which, according to the best judgment that can at present be formed of them, appear to be hieroglyphics of very remote antiquity. A programma of these has been published, and a more detailed work on the subject is expected.

In connexion with the supposed characters on what have been called the written rocks, in the state of Massachusetts, North America, these hieroglyphics possess considerable interest. They may perhaps determine whether those in America are really the results of art, or only the accidental effects of water. If, however, they do not clear up this point, they will still be very important for their own sakes, and for the illustrations they will offer of the progress of written language.

Art. XXIII. METEOROLOGICAL DIARY for the Months of March, April, and May, 1819, kept at **Earl Spencer's** Seat at Althorp, in Northamptonshire. The Thermometer hangs in a north-eastern aspect, about five feet from the ground, and a foot from the wall.

For March, 1819.							
		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Monday……	1	32	37	29,24	29,27	E	NE
Tuesday ….	2	33	39	29,31	29,43	NE	NE
Wednesday ..	3	34	41	29,55	29,72	NE	ENE
Thursday….	4	32	44	29,85	29,90	NNE	N
Friday ……	5	38	45	29,94	29,90	NE	NbE
Saturday ….	6	40,5	47	29,86	29,90	NE	NE
Sunday ……	7	40	47,5	30,00	30,08	NE	NE
Monday……	8	38	43,3	30,08	30,05	NE	NE
Tuesday ….	9	34	50	30,03	30,03	NW	W
Wednesday ..	10	43	48	30,03	29,98	W	NW
Thursday….	11	39	59	30,00	30,00	NW	WNW
Friday ……	12	38	48	30,09	30,12	W	NW
Saturday ….	13	42	47	30,20	30,20	W	NW
Sunday ……	14	41	48	30,22	30,19	W	SW
Monday……	15	39	52	30,09	30,00	SW	SW
Tuesday……	16	42	56	29,92	29,88	SW	WbS
Wednesday ..	17	41	44	29,99	30,04	W	WbN
Thursday …	18	29	45	30,10	29,97	WbN	W
Friday ……	19	36	48	29,47	29.28	SW	W
Saturday ….	20	37	46	29,30	29,50	WbN	W
Sunday ……	21	34	45	29,70	29,70	NW	NW
Monday……	22	35	48	29,70	29,67	W	W
Tuesday……	23	37	58	29,60	29,57	SE	S
Wednesday ..	24	43	54	29,40	29,47	SW	W
Thursday….	25	39	51,5	29,49	29,49	WbS	W
Friday ……	26	38	51	29,64	29,74	WbS	SW
Saturday ….	27	44	52	29,74	29,65	SW	SW
Sunday ……	28	43	55	29,60	29,60	SW	SW
Monday……	29	41	57	29,55	29,55	SW	SW
Tuesday ….	30	43	57	29,77	29,80	W	SW
Wednesday ..	31	49	63	29,90	29,93	W	WbS

For April, 1819.							
		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Thursday ….	1	47	62	29,97	30,00	SW	SW
Friday ……	2	46	58	29,98	30,00	NW	E
Saturday ….	3	38	60	29,90	29,90	NW	E
Sunday ……	4	42	56	30,00	30,00	EbS	SE
Monday……	5	39	54	30,00	29,93	W	E
Tuesday ….	6	34	52,5	29,87	29,61	E	E
Wednesday ..	7	40	62	29,57	29,57	E	ESE
Thursday ….	8	48	60	29,70	29,80	E	NW
Friday ……	9	36	55	29,87	29,90	W	W
Saturday ….	10	37	58	29,90	29,60	W	W
Sunday ……	11	41	56	29,30	29,20	W	SW
Monday……	12	32	49	29,20	29,20	SE	NE
Tuesday ….	13	44	54,5	29,13	29,22	E	W
Wednesday ..	14	36	55	29,37	29,33	SE	SW
Thursday ….	15	39	57	29,30	29,30	W	SSE
Friday ……	16	43	52	29,02	29,10	E	WbS
Saturday ….	17	42	54	29,17	29,27	W	SW
Sunday ……	18	40	53	29,47	29,52	SW	W
Monday……	19	36	55	29,62	29,70	SW	SW
Tuesday ….	20	48	59	29,57	29,52	E	S
Wednesday ..	21	46	57	29,48	29,57	SW	W
Thursday ….	22	41	48	29,70	29,78	NW	NE
Friday ……	23	40	50	29,73	29,64	E	NE
Saturday ….	24	43	46	29,55	29,60	E	NE
Sunday ……	25	41	50	29,77	29,90	E	NE
Monday……	26	32	51	30,07	30,05	NE	NE
Tuesday ….	27	32	51,5	30,05	30,10	NE	E
Wednesday ..	28	29	56	30,10	30,07	SE	ESE
Thursday ….	29	32	59	30,00	29,90	SE	E
Friday ……	30	32	59,5	29,85	29,75	E	SE

For May, 1819.							
		Thermometer		Barometer		Wind	
		Low	High	Morn.	Eve.	Morn.	Eve.
Saturday ….	1	35	63	29,71	29,68	SE	SE
Sunday ……	2	42	68	29,63	29,57	SE	SE
Monday……	3	49	70,5	29,54	29,50	SE	E
Tuesday ….	4	51	63	29,42	29,43	SE	E
Wednesday ..	5	49	64	29,43	29,54	SE	SE
Thursday ….	6	42	65	29,77	29,87	SSE	S
Friday ……	7	40	66	29,90	29,90	SbW	NW
Saturday ….	8	50	71	29.92	29,92	NE	ESE
Sunday ……	9	47	73,5	29,98	29,98	SE	SW
Monday……	10	44	70	30,04	30,04	W	W
Tuesday ….	11	53	69	30,01	30,00	SW	W
Wednesday ..	12	48	71,5	29,98	29,95	W	W
Thursday….	13	46	65	29,95	29,95	W	WbN
Friday ……	14	41	63	30,00	30,00	W	W
Saturday ….	15	39	69	30,00	29,90	W	E
Sunday ……	16	44	71	29,90	29,89	W	SW
Monday……	17	39	71	29,89	29,75	S	SW
Tuesday ….	18	43	70	29,67	29,69	SW	W
Wednesday ..	19	50	55	29,65	29,49	SE	NE
Thursday ….	20	48	55,5	29,48	29,50	N	NNW
Friday ……	21	47	60,5	29,48	29,42	NE	SE
Saturday ….	22	40	62	29,55	29,60	E	SE
Sunday ……	23	38	71	29,80	29,80	E	E
Monday……	24	49	57	29,80	29,83	E	E
Tuesday ….	25	47	57	29,86	29,80	NE	NE
Wednesday ..	26	46	57	29,80	29,82	NE	NE
Thursday ….	27	43	62	29,80	29,72	NE	NW
Friday ……	28	40	59,5	29,79	29,80	NE	NbW
Saturday ….	29	34	58	29,80	29,84	NW	NE
Sunday ……	30	31	59,5	29,88	29,85	W	W
Monday……	31	44	63,5	29,95	29,95	W	W

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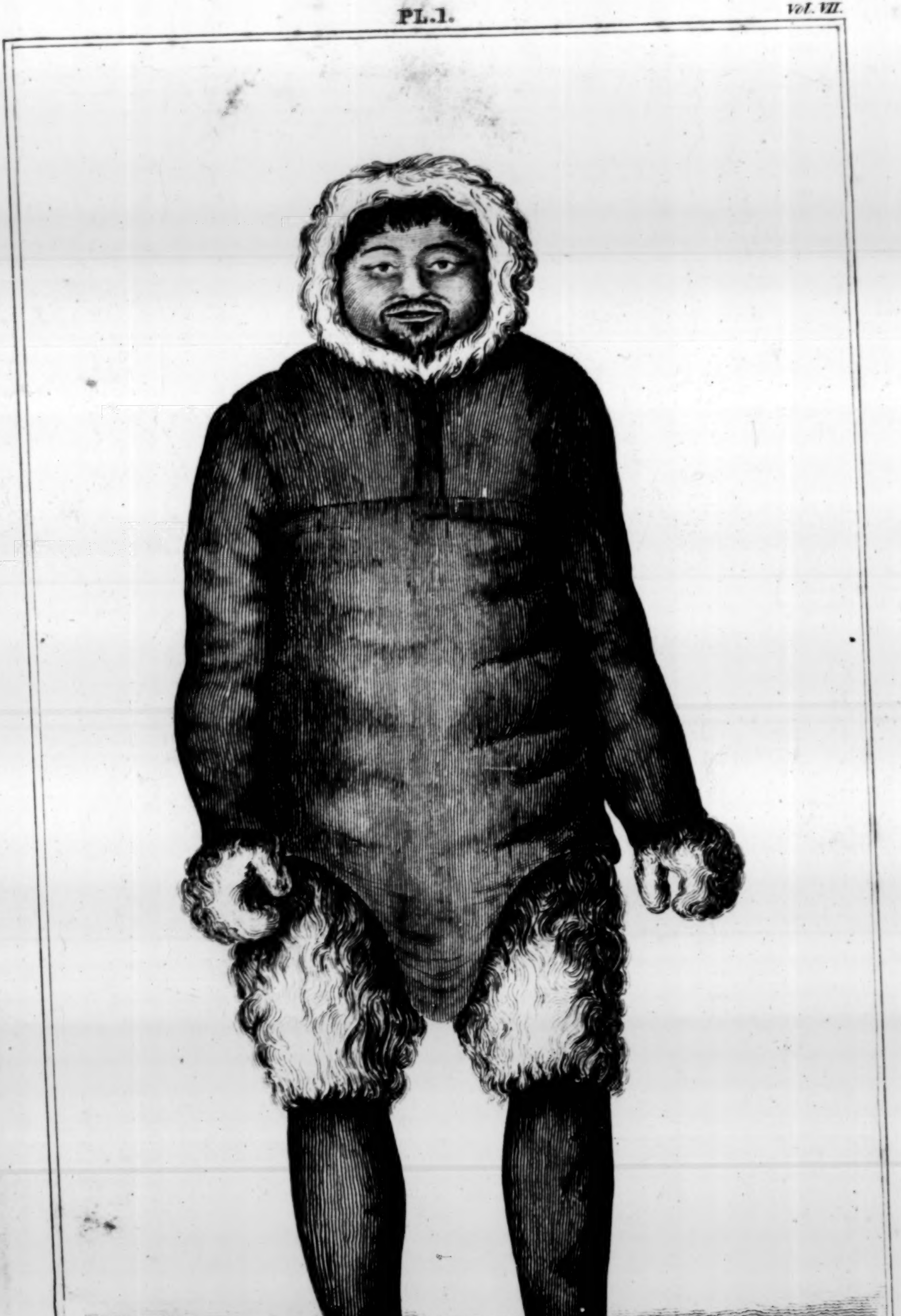

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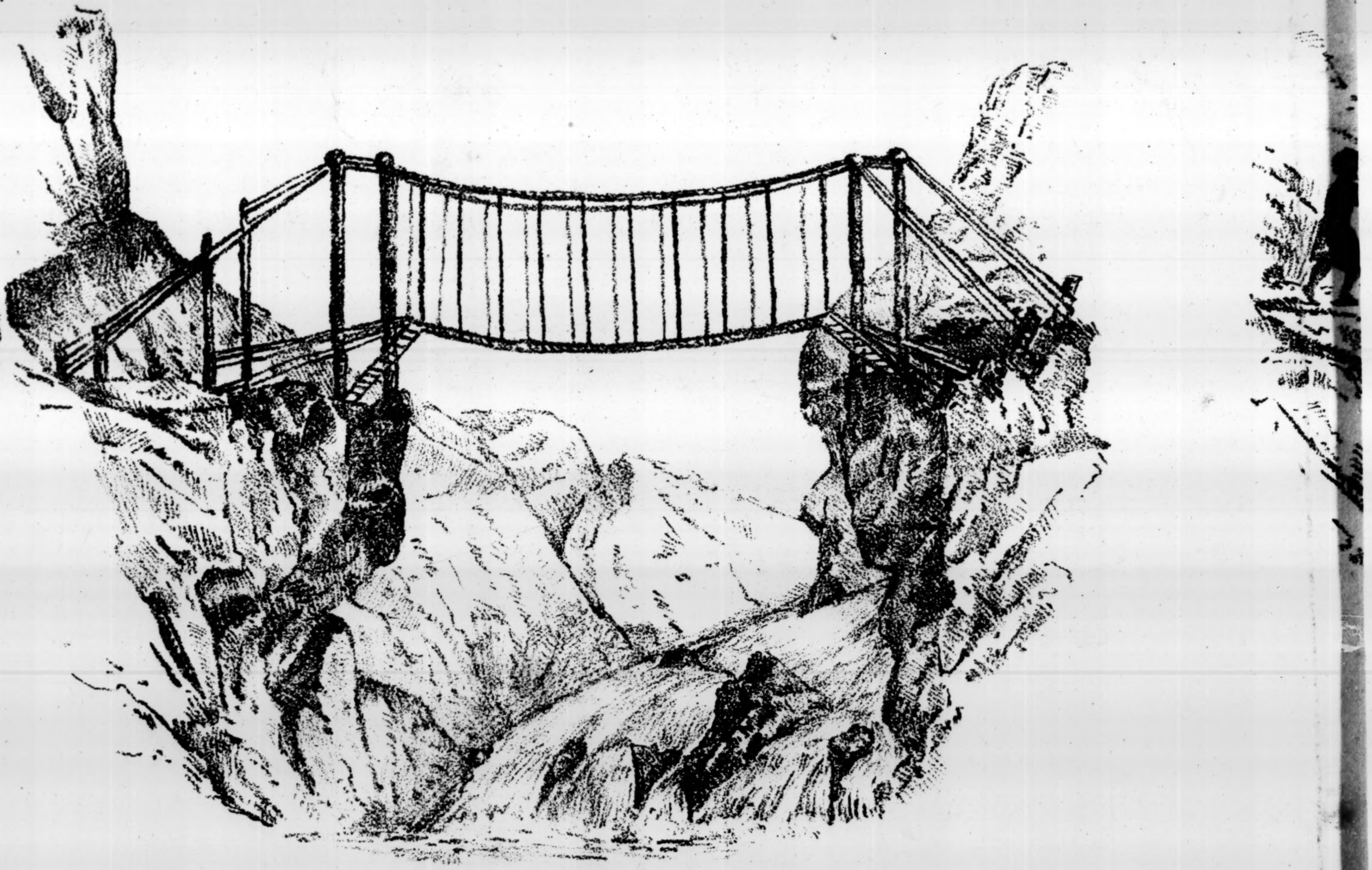

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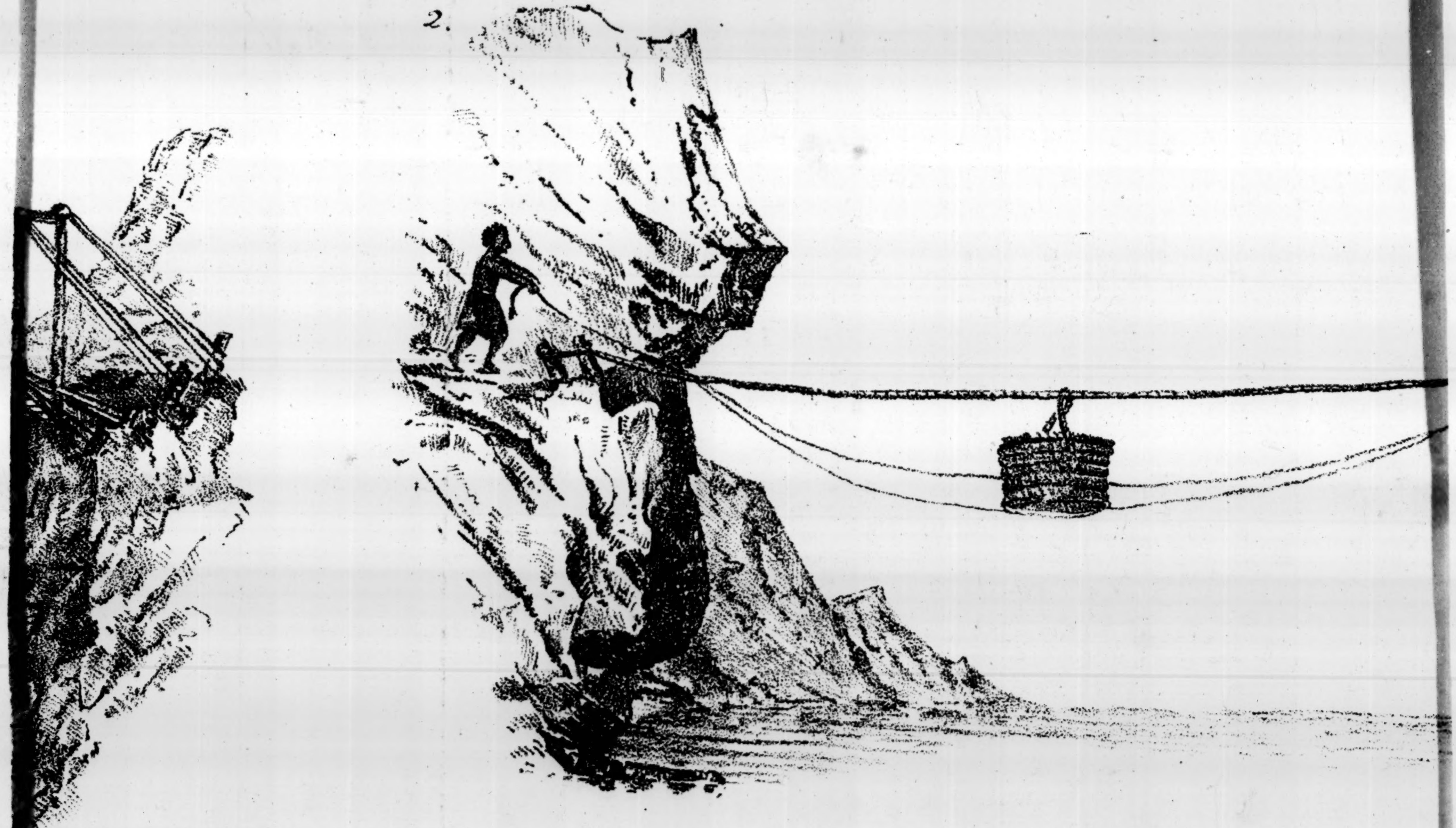

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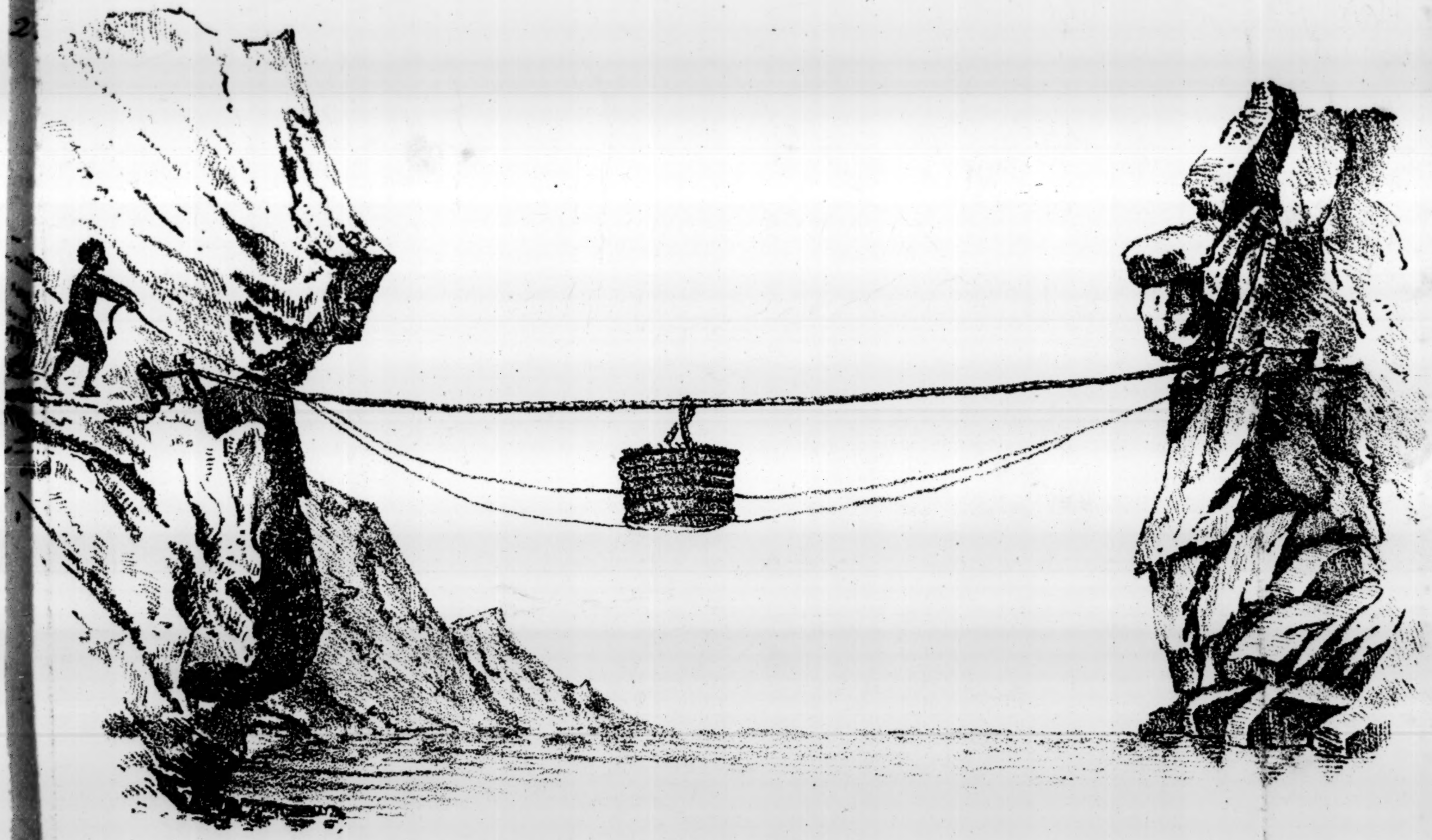

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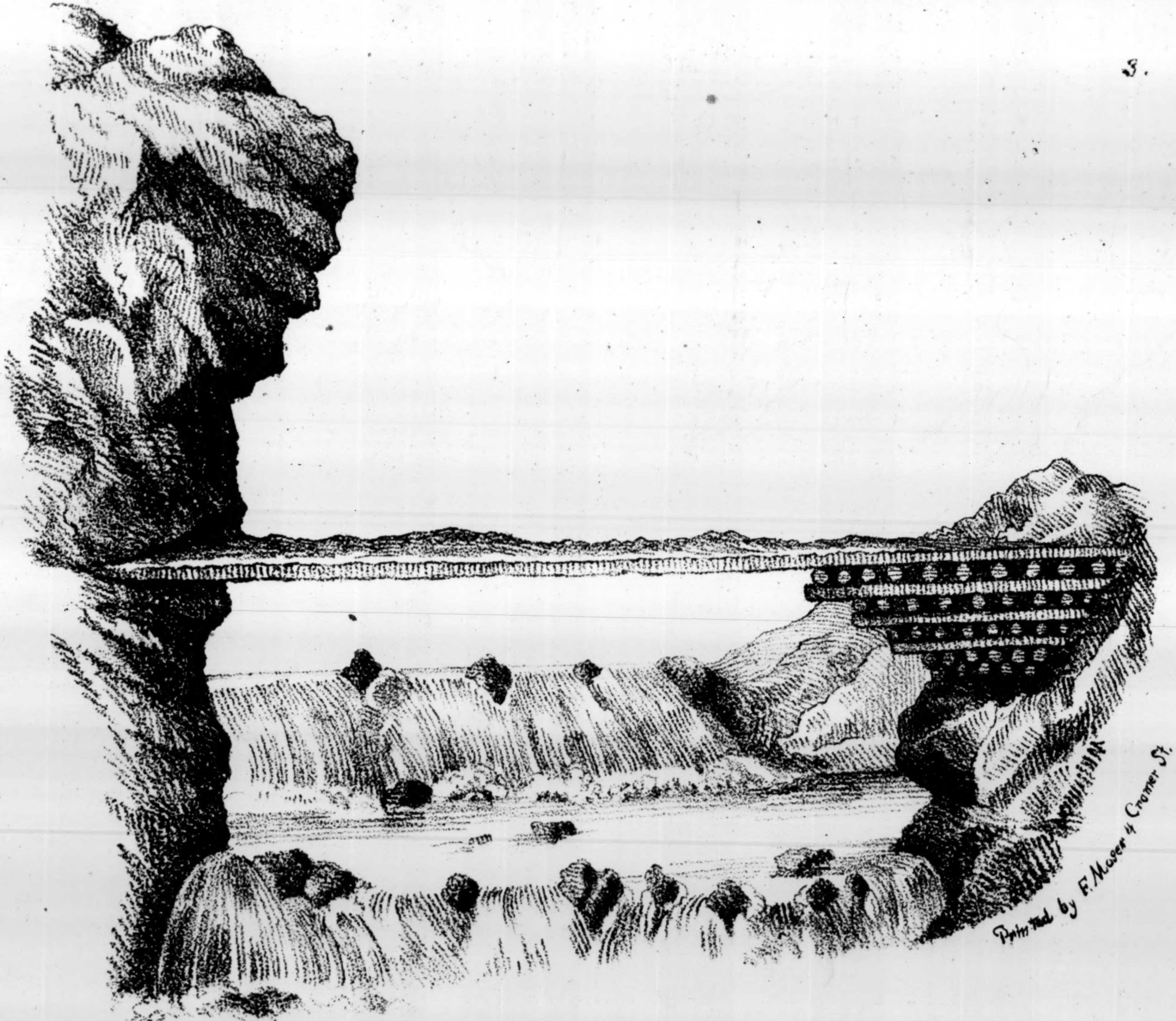

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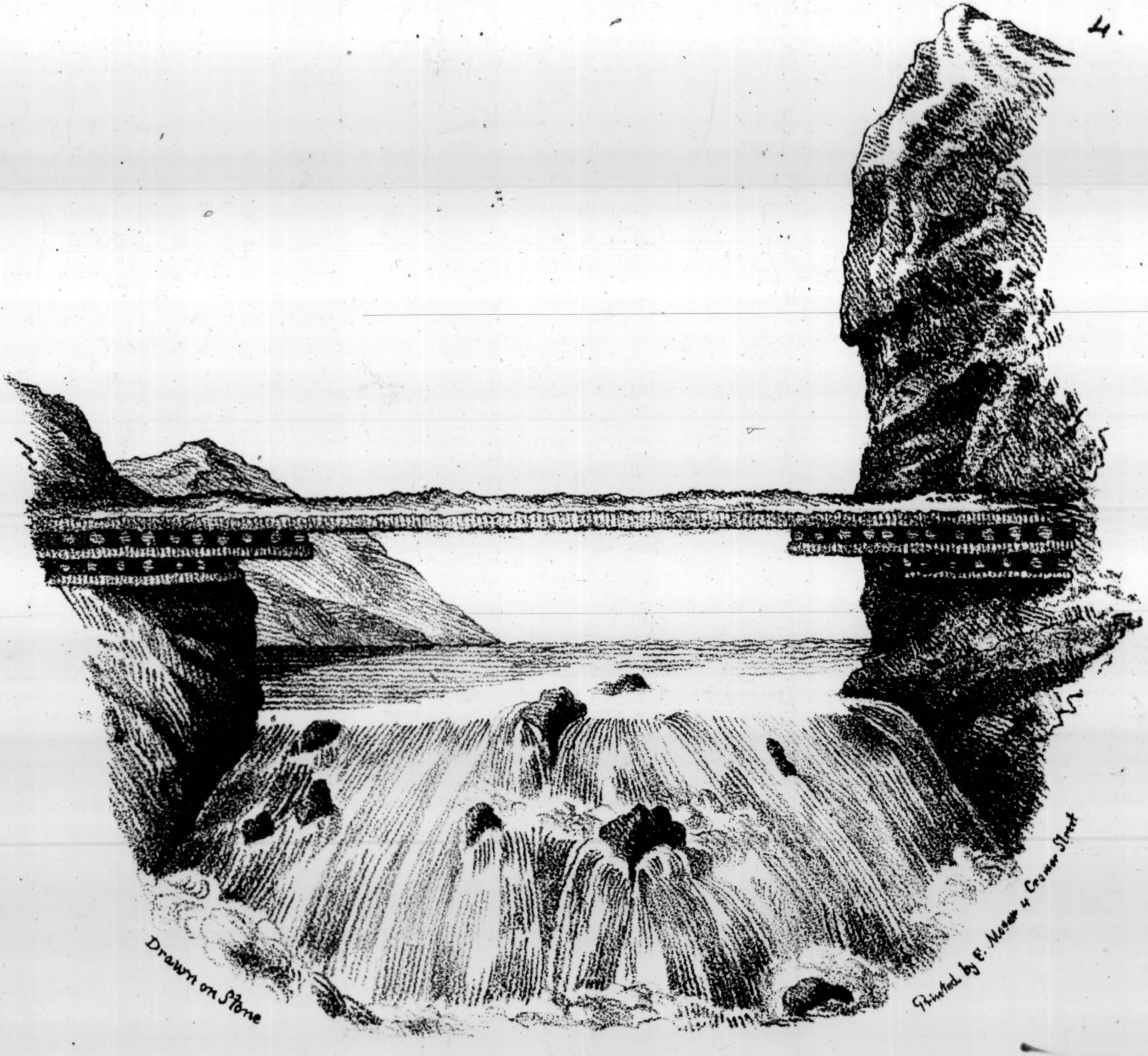

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